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Pulleys Predominate in Unique Shop

Economy of Operation Largely Is Due to the Ingenious and Unconventional Manner in Which at Times the Mechanical Equipment of the Foundry Is Employed

BY PAT DWYER

FOUNDRIES engaged in the production of gray iron castings may be divided roughly into three general classes. These include shops which specialize in one exclusive line of which the stove plate, agricultural and automotive industry offer fair examples; those known as jobbing foundries, which are prepared to handle practically any size or type of casting within their limitations; and a third class devoted primarily to the production of a definite line of castings, but which owing to the fluctuating nature of the demand for that product depend on the general jobbing trade for sustained business and to keep their shops filled with work. Under normal conditions, the amount of this outside work in foundries of the third class may average 20 per cent of the total output, increasing in periods of depression to 50 per cent and decreasing at other times to the vanishing point. Much of the fill-in work handled in this way differs so widely from the regular work that special rigging and equipment is required to handle it. However, a considerable portion of it by the exercise of a little ingenuity, may be adapted to fit in with the requirements of the existing equipment and rigging and thus may be handled in an economical manner. The practice pursued at the plant of the Hill Clutch Co., Cleveland, illustrates this point in an interesting manner.

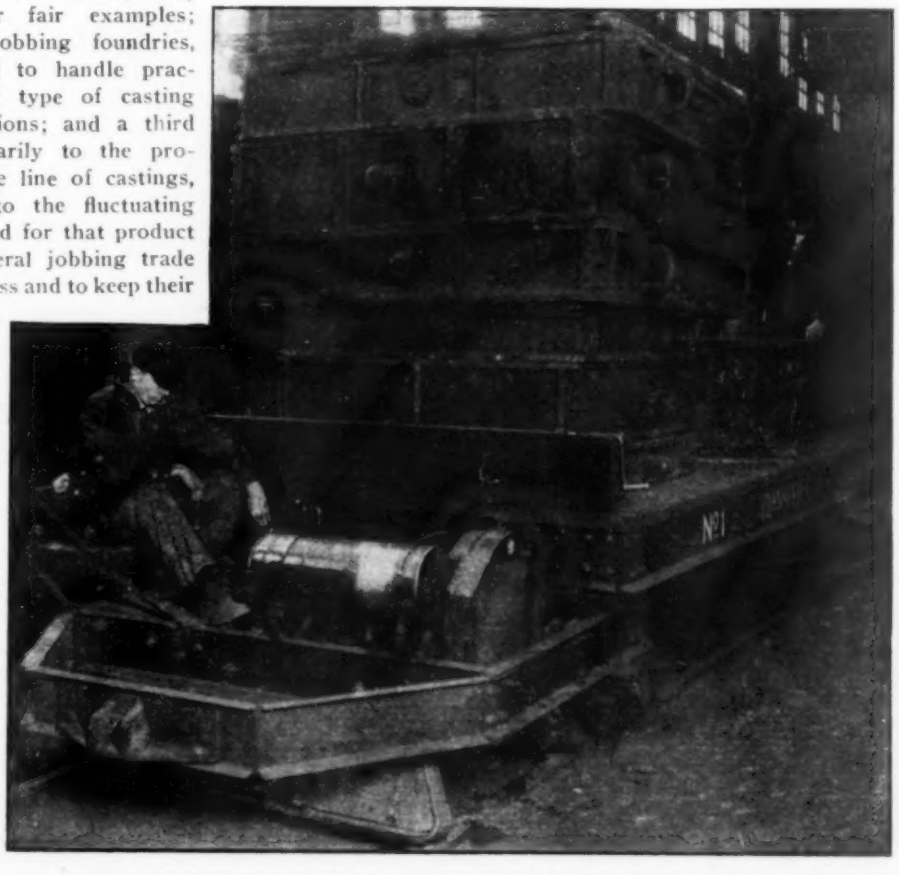


FIG. 1—SELF-PROPELLED STANDARD GAGE TRUCK POWERED WITH A REBUILT AUTOMOBILE ENGINE

This company specializes in the manufacture of belt and rope driven power transmission machinery and the foundry is equipped in a special manner for the economical production of pulleys, gears, couplings, hangers, bearings and everything connected with the complete installation of a mechanically operated industry. As a manufacturer of this type of equipment it is only natural to find that the company employs labor saving equipment extensively around its own plant and adapts many of the mechanical units in a way never contemplated by their originators. The foundry building, which

FIG. 2—COKE IS HOISTED BY A LOCOMOTIVE CRANE

was erected in 1907, was considered one of the most modern and up to date at that time. It was one of the first to break away from the traditional old dark buildings provided with high up narrow windows thickly coated with dust through which rays of light only penetrated when a pane of glass happened to get knocked out. The greater part of the area of the walls is formed of steel sash and in addition adequate light is distributed to every part of the floor through a monitor roof extending all the way across the center bay and furnished with saw tooth sky lights.

The building is 121 x 242 feet. It is divided into three bays and as far as possible all the incoming work is sorted into three general classes and each class assigned to the bay designated for that purpose. One bay is devoted almost entirely to pulleys, shaft hangers and bearings. Part of the molding machine equipment in this bay consists of one roll-over machine made by the Grimes Molding Machine Co., Detroit; two gravity type machines made by the American Foundry Equipment Co., New York and a battery of stripping plate pulley machines made by the company itself.

Heavy work of all kinds is made both in flasks and in the floor in the center bay which is spanned by two cranes, one of 15 tons capacity and the other of 10 tons capacity, supplied by the Niles-Bement-Pond Co., New York. The two largest pulley making machines are situated close to one end of this bay. Each of these machines is equipped to make pulleys between 62 and 72 inches diameter inclusive. Pulleys over 72 inches in diameter are made in the floor either from individual patterns or from sweeps, or from a combination of sweeps and cores.

All medium size castings ranging from 300 to 1000 pounds in weight are made in flasks in the third bay. In addition to two 10-ton cranes an industrial track laid on the floor in the center of this bay facilitates the movement of empty flasks into and out of the shop and also serves to convey buggie ladles of iron from the cupola to any point on the floor. In fact this industrial track extends the full length of both side bays and is connected by suitable turntables with a branch running across one end in front of the cupola and another branch leading into the flask yard.

Handling Outside Material

The narrow-gage tracks formerly communicating with every section of the yard have been displaced to a considerable extent by a standard-gage track system. It is possible to shunt cars directly from a spur connecting with the lines of the New York Central railroad to any point in the company's property. One of the principal reasons for this change from narrow-gage to standard-gage tracks was the ever increasing number of uses found for a locomotive crane. A great many of the flasks employed in the foundry are made of iron and are large and heavy and difficult to handle. With the crane equipment, provided in the foundry, it is a relatively simple matter to handle the flasks once they are inside the building; but loading them and unloading them in the yard frequently presented slow and expensive problems.

A modified type of gantry crane equipped with a hand operated chain block served the purpose in a more or less indifferent manner for some time. Naturally its range of usefulness was limited and resulted in the practice of piling several flasks, not necessarily the

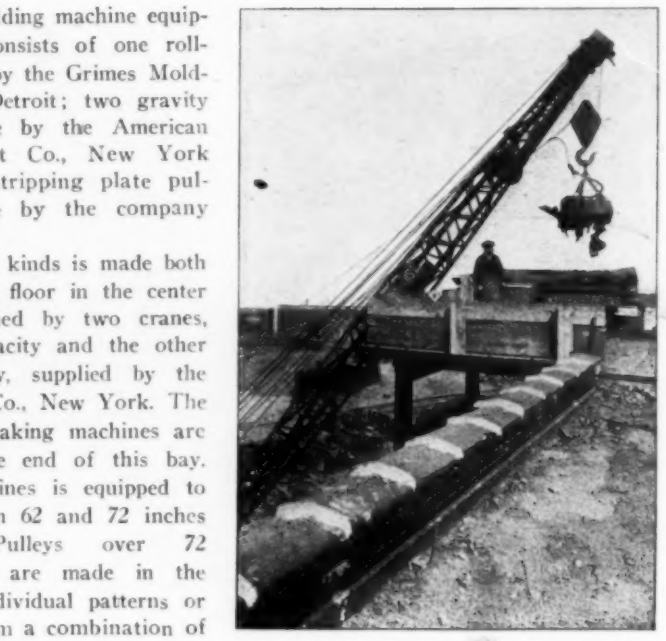


FIG. 5—THE IRON IS PICKED UP BY A MAGNET

FIG. 3—PART OF THE FOUNDRY YARD

FIG. 4—THE CHARGES FOR THE CUPOLA ARE MADE UP ON A PAN MOUNTED ON A SCALE CAR WITH A SPECIAL DUMP PAN

same size, on top of each other. With the perversity seemingly peculiar to inanimate objects around a foundry it usually was found that whenever a particular flask was wanted it would be discovered at the bottom of the pile.

The locomotive crane dispenses with all that kind of trouble. The yard is large and roomy and flasks may be set down any place and picked up again when necessary with a minimum of trouble and expense.

Other uses for the locomotive crane are shown in Figs. 2, 3 and 5. The coke, pig iron and scrap are unloaded and stored in piles close to the end of the building in which the cupola is located. The charging platform has been extended outside of the building as partly shown in Figs. 2 and 5 and the crane is employed to lift all the materials for the charge.

Charging Floor Facilitates

A wood box provided with trunnions at the ends is used to transfer the coke from the storage pile to the charging platform. An equalizer beam equipped with a pair of slings is attached to the crane hook and serves to balance the load while the crane is lifting it. After landing on the truck provided for that purpose the box of coke is pushed by hand along a narrow gage track until it approaches the cupola. Here the beam is attached to the hook of a small electric hoist, the box is lifted, turned over and the coke spilled in a pile close to one side of the cupola as shown in Fig. 4.

A number of small trucks, like the one shown at the extreme left in Fig. 4 are used for making up the charges of pig iron and scrap. Each truck is run out in turn to the end of the charging floor extension and there loaded by a magnet attached to the hook of the locomotive crane. Each kind of material including light scrap, heavy scrap, steel scrap and pig iron is loaded in separate boxes, the approximate amount of each kind required being determined every morning. As each car is loaded, it is pushed along a track into the charging room and allowed to stand until the time comes for charging the furnace.

The iron is melted in a 72-inch cupola lined to 54 inches made by the Whiting Corp., Harvey Ill. The usual charge of iron consists of 2000 pounds with 200 pounds of coke between the charges. The character of the iron forming the total charge varies, depending on the general character of the work going through the shop at any given time. For light pulleys a 60-40 pig iron scrap mixture is used. The pig iron employed for this purpose will range between 2.75 and 3.00 per cent silicon, with low sulphur and phosphorus while the scrap used in the same mixture is high grade machinery scrap. For the ordinary run of work in the shop a 50-50 mixture of pig iron and scrap is employed and for heavy machinery and special pieces, gears, etc., steel scrap in varying proportions is incorporated in the mixture.

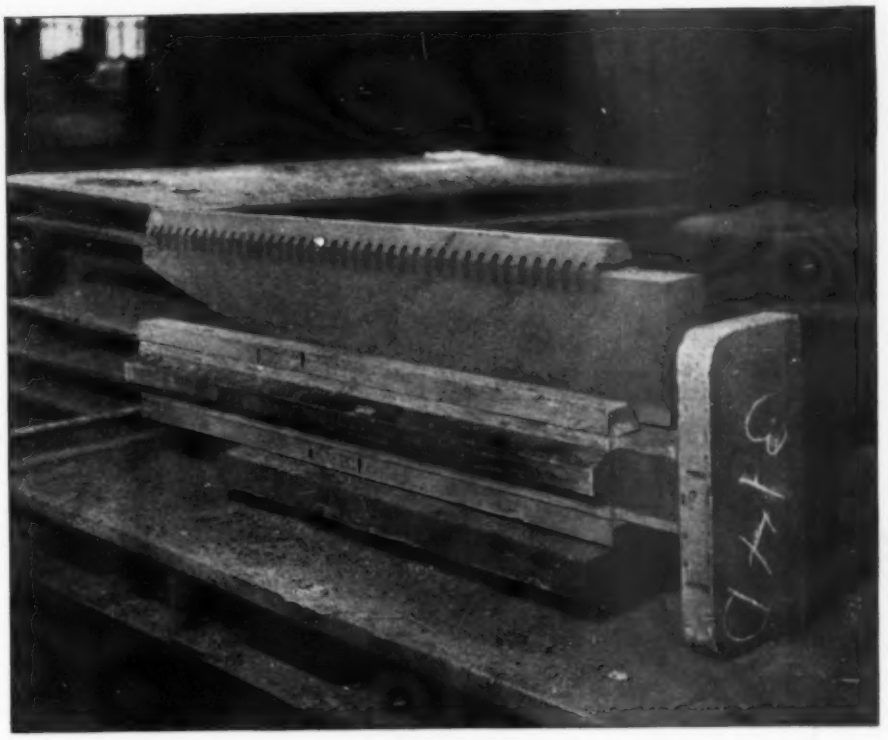


FIG. 7—PATTERN AN DCORE EMPLOYED FOR MAKING A RACK

Weighing the Charges

The specially designed scale car and charging device shown in the right foreground of Fig. 4 has been developed for charging the cupola. The advantage of using this device lies in its ability to place a ton of iron in the cupola at a time. In practice the men who charge the furnace shove the combined scale and charging car close to a buggyload of pig iron or scrap as the case may be. Enough of this material is transferred to the scale car to make up the required proportion of any given charge. The car then is shoved forward until the lip engages the cupola door frame.

Then the scale pan is lifted at its forward end by an automatic toggle thus relieving the weighing mechanism.

At this point the hook of an electric hoist is attached to a suitable connection provided at the back of the charging pan. The back of the pan is elevated

FIG. 6—GENERAL VIEW OF MAIN BAY LOOKING FROM THE CORE ROOM

FIG. 8—MACHINES ON WHICH PULLEYS UP TO 72 INCHES IN DIAMETER ARE MADE—BY THE AID OF ADJUSTABLE RINGS, ARMS AND HUBS PRACTICALLY ANY STYLE OF PULLEY BETWEEN 5 AND 6 FEET IN DIAMETER CAN BE PRODUCED WITH COMPARATIVE EASE

thus automatically discharging the contents into the cupola.

A sufficient number of cars are provided to hold the entire charge under ordinary circumstances; but a switch is provided whereby if necessary the cars can be deflected when emptied and returned to the extension of the charging platform outside the building there to be refilled by the magnet attached to the hook of the locomotive crane.

A separate building 28½ x 59 feet close to the end of the main building houses the power plant. Current is obtained from the Cleveland Electric Illuminating Co. and is used to drive two Allis-Chalmers rotary transformers for direct current crane service. A positive pressure blower made by the P. H. & F. M. Roots Co., Connersville, Ind. and geared to a 40-horsepower motor furnishes the blast for the cupola. Compressed air at 100 pounds pressure is supplied by a compressor made by the Bury Co., Erie, Pa. and is driven by a 150-horsepower motor. There is also a cross-compound Ingersoll-Sargent compressor geared to a 60-horsepower motor.

Pattern Shop Close By

The pattern shop which also serves as a flask repair shop is located outside of one end but under the same roof as the foundry. It is provided with the usual power operated wood working tools for making wood patterns and also with minor facilities for preparing metal patterns. The company maintains an extensive machine shop and all the major operations in the preparation of metal patterns are carried on there.

The core ovens, core room, benches, sand mixing machinery and wash room all are located at one side of the building, opposite to the power plant and cupola department. At one time two core rooms were in operation, one employing female operatives alone. At the present time all the core room employes are either men or boys.

Machine-made stock cores and the flat splitting cores used so extensively in pulleys, clutches, etc., are made with an oil sand mixture containing nothing but new sand and oil. All the other cores contain a certain percentage of old sand depending on their bulk and general characteristics. An instance of one of the minor economies practiced and also of how advantage is taken of opportunities in the plant is illustrated in the method adopted for reinforcing circular cores. In the process of machining the pulleys, rings from ½-inch to 1-inch frequently have to be cut off. These rings are taken to the foundry and are rammed up in cores of circular cross section. This utiliza-

FIG. 9—GRAVITY TYPE MOLDING MACHINE ADAPTED TO MAKING SMALL PULLEYS TWO AT A TIME IN RECTANGULAR FLASKS

tion of an apparently waste product relieves the foundry from the expense of either bending rods or of making open sand arbors. After the rings have served their purpose and been broken up in their removal from the cores during the process of cleaning the casting they are gathered up with the foundry scrap and ultimately reach the charging platform.

Transfer Cars Used

A standard-gage track is laid across the floor at the opposite end of the shop from that which has been touched upon in the foregoing paragraphs. On one side this track extends through the cleaning room and thence to the machine shop. On the other side it passes through a large doorway in the side of the building into the yard where it is connected by suitable switches with the standard track system in the yard.

A unique type of car, designated to convey material on this track is shown in the illustration Fig. 1. It was designed by Harry Smith, works manager, and built under his supervision in the company's shops. The body of the car, as may be noted, is constructed of a rectangular frame made up of four pieces of steel I-beams. The upper side is floored with 2-inch planking and the braces on the lower side are supported on standard axles terminating in wheels and journal boxes of the regular railroad type.

FIG. 11—ONE OF THE SMALLER SIZE PULLEY MACHINES ADAPTED FOR MAKING THE JOB SHOWN IN FIG. 10

The motive power for this somewhat extraordinary vehicle is furnished by a discarded automobile motor which was rescued from the junk pile, repaired, reconditioned, adapted and attached to the frame as shown in the illustration. The energy is transmitted from the engine to the main gear on the front axle of the truck through a train of suitable gearing designed on the same lines as those on the ordinary street car.

It is claimed that the car has effected great economies in conveying large castings to the machine shop, while on account of the comparative ease with which flask may be carried out of and into the shop there is no longer any need of allowing large flasks to lay around the floor taking up valuable room when they are not in use. The section of track, crossing the main bay of the foundry, comes within the area served by one of the overhead traveling cranes, thus rendering it relatively simple to load the car while the facilities afforded by the elaborate trackage system in the yard makes it just as easy with the aid of the locomotive crane to unload the flasks, etc., at any given point.

Pulleys Made on Machines

The two machines on which pulleys, up to and including 72 inches in diameter, are molded are shown in Fig. 8. They are not molding machines in the usual sense, inasmuch as the sand in the molds is rammed entirely by hand. Of course pneumatic rammers are employed, but the flasks are gaggered, filled with sand by courses and rammed as in ordinary foundry practice. The principal function of

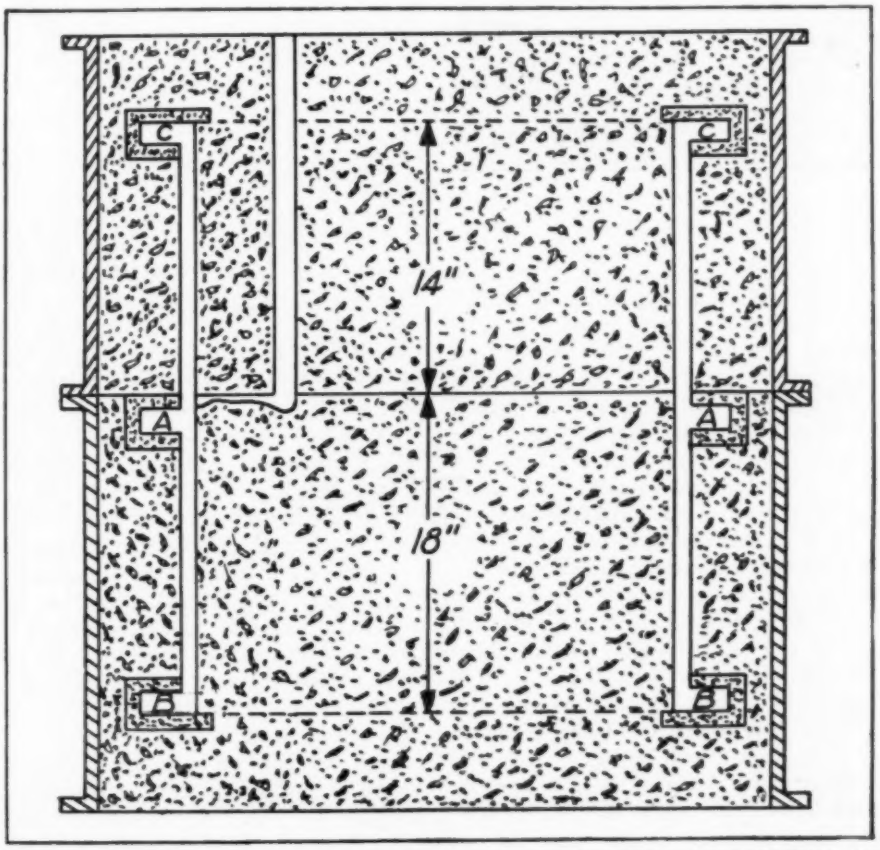


FIG. 10—SECTIONAL VIEW OF ASSEMBLED MOLD SHOWING APPLICATION OF THE FLANGE CORES

the machine is to provide a perfect surface on which to ram the molds and also as a stripping plate by which to draw the pattern. A set of 6 ring patterns 1 foot deep and advancing through 1-inch gradations forms part of the equipment of each machine. The ring drops through an opening provided for that purpose in the face plate and is attached to a cradle underneath. By a simple gear arrangement controlled by the hand wheel, shown at *W* Fig. 8, the cradle may be elevated or depressed, taking the pattern with it. By the same device any desired face can be secured on a pulley.

Loose hubs and sets of arms are provided in almost endless variety. The face plate of the machine is provided

FIG. 12—MANY OF THE PATTERNS ARE PROVIDED WITH COVERING CORE PRINTS A FEATURE WHICH GREATLY SIMPLIFIES THE MOLDING OF PATTERNS HAVING DEEP POCKETS ON THE COPE SIDE

with hexagonal radial lines and on these lines suitable pin holes have been drilled to locate corresponding pins in the pulley arm patterns. With this outfit it is possible to produce practically any combination of face, hub and arms in any given pulley. In the same way the flasks are so arranged that pulleys ranging through a variation of 3 inches in diameter may be made in the same flask.

The copes and drags on the pulley flasks are alike. They all are machined on the joints and accurately drilled through a jig to receive two guide pins at diametrically opposite points. The pins are not fitted in permanently but are employed as occasion demands, first in locating the flask on the pattern plate and later in locating the cope on top of the drag.

In practice, after the proper size ring, hub and arms have been adjusted on the pattern plate, the drag half of the flask is set on, being located by the two pins previously referred to. Facing sand is distributed over the arms and hub after which the joint face of the mold is gaggered precisely as if it were a cope being rammed. Care is taken in the case of the drag that the shanks of the gaggers do not extend above the tops of the bars.

After the flask has been rammed, the ring pattern is drawn down through the stripping plate and then the drag is lifted off and turned over. A level bed of soft sand, 2 or 3 inches thick is prepared on the floor a short distant away from the machine and the drag is lowered carefully on this bed and rubbed to a bearing. The pattern plate then is cleared off with a brush and a few blasts from an air hose and after the ring pattern has been pushed up through the plate once more to the proper height, the cope half of the flask is set on and rammed in a manner similar to that employed for the drag. In fact the only difference between ramming a cope and a drag lies in the fact that it is necessary to set a couple of gate pins on top of the hub in the case of the cope. One of these gate pins is larger than the other and is used as a *feeder* after the casting is poured. The hubs on most of these large pulleys are quite heavy and it is necessary to churn them for a short time before the metal solidifies.

The cope half of the mold is not turned over after it is lifted off the machine. The flask is held suspended on the crane while the molder removes the hub pattern, reams out the gates and brushes plumbago on the hub and arms of the mold. It then is lowered onto the drag, where after the two halves of the mold have been clamped together and a runner basin made up to convey the iron from the side of the flask to the center, it is ready to be poured.

Solid and Split Wheels

Many of these pulleys are cast *solid* which means that they will remain and be handled as single units, one-piece castings until the end of their useful industrial existence. It will be necessary to insert the shaft in the hub before the piece of machinery is erected and, in case from any one of a hundred different causes, it later becomes necessary to remove the pulley it may be necessary to take down a whole line shaft or disassemble a complete machine to do so.

For this reason and occasionally on account of problems connected with contraction strains, a great many pulleys are cast *split*.. A point is selected midway between two arms on diametrically opposite sides of the rim and suitable lugs provided with prints for the bolt cores and splitting cores attached thereto. A pair of similar lugs are attached to each side of the hub. Of course all the lugs are arranged to come in a straight line.

After the mold is made and before the two halves are brought together, thin flat cores are inserted in the prints provided for that purpose at the hub and rim of the wheel. Although the purpose of the cores is to cut the *wheel* in two they do not divide the *mold* into two parts. These thin flat cores are kept back varying distances from the face of the rim and from the center core, depending on the size of the pulley and the amount of metal to be removed in the machine shop.

The casting is poured as a unit as in the case of a *solid* wheel. It is not until it has been taken to the machine shop that it is split. Then the two halves are bolted together and the hub bored and finished and the rim turned to size and finished crowned or straight according to specifications. It readily is apparent that a pulley split in two can be assembled on a shaft in a minimum of time irrespective of the position of the shaft or of any other pieces of equipment attached thereto. It also follows that since the wheel was machined as a unit it will be perfectly round when

the two halves are reassembled and the irregular character of the break produced in forcing the two halves apart is a guarantee that they will occupy their proper relative positions when they finally are bolted together.

An interesting illustration of how standard equipment is adapted to cope with occasional emergency jobs is shown in Figs. 10 and 11. In this instance a 24-inch pipe connection 32 inches long, flanged top and bottom and provided with a reinforcing flange around the center was made on one of the regular pulley making molding machines. The only pattern-making expense in connection with this job was charged to the construction of a corebox for making the flange cores. Several of the cores are shown on the board on Fig. 9, and the method of their application in the completed mold is shown at *A B* and *C* in Fig. 10. It will be noted that the cores on the top and bottom flange are alike, while to make the cores for the center flange it only was necessary to drop a *stop-off piece* in the deep flange of the corebox.

Had the parting line been drawn exactly through the center of the reinforcing rib, it would have been necessary to split each core at that point and carry one half in the cope and the other half in the drag. To avoid this contingency the parting line was arranged to come above the center flange plus the thickness of the flange core. This point is clearly illustrated in Fig. 10.

In making the mold the ring pattern first was adjusted to a height of 18 inches above the face plate of the machine. A sufficient number of the cores, shown at *AA* Fig. 10, to form a complete ring were set on the face plate close up against the pattern, after which the drag flask, in this instance made up of three sections bolted together, was set on and sand rammed up almost to the top of the pattern. At this point the cores *BB* were slipped down between the bars and tucked into place. It will be noted that each core is provided with a long and a short flange. The long flange is designed to rest on the top of the pattern and thus insures that the complete flange will be even and straight.

Two Pulleys in One Flask

After the flange cores were set, the remainder of the cope was rammed in the usual way, then the pattern was stripped and the drag lifted off the machine and set on the floor. The cope was rammed in the same way with the exception that no flange cores were employed at the joint. Also the pattern was set at 14 inches instead of 18 inches above the face plate as in the case of the drag. The cores shown at *CC*, Fig. 10, are similar to those at *BB* and were adjusted in the mold in the same manner. A single upright runner, communicating with the inside of the mold at the parting line was employed for conveying the iron into the mold.

A wide variety of work is made on the gravity type machines one of which is shown in Fig. 9, engaged for the time in making pulleys. The orders for pulleys occasionally are in excess of the capacity of the regular pulley machines. While it is possible to use the regular pulley flasks on this machine it has been found that it is more economical to employ standard rectangular flasks large enough to contain two patterns at the same time. Each machine is served by a light I-beam jib crane equipped with a 1-ton, hand-controlled, electric hoist as shown.

The pattern boards used with the gravity machines are finished absolutely true on the upper surface and provided with center and radial lines, also pin holes for locating the patterns and flasks. The type of flask used is shown in Fig. 9. It has been found that this style of flask is a material aid to production when a gang of three or more men are employed on the same job. While the crane is transferring a rammed flask from the machine to the floor, two men easily can lift an empty flask onto the machine table. The metal thickness in the flasks is reduced to a minimum, but the generous distribution of vertical and longitudinal ribs on the outside renders them sufficiently strong and rigid.

Many of the bearings and other patterns which if made in the usual way would entail a deep heavy *lift* in the cope are provided with core prints similar to the two patterns shown in the center of Fig. 12. Core boxes are provided and dry sand cores made. In this way all the intricate and difficult features incident to work of this character, features which entail the services of skilled molders, are eliminated. In many instances copes may be dispensed with altogether since the core acts as a complete cover. In other cases copes are employed, partly because the core does not completely cover the mold and partly because it may be necessary to provide a *head* of metal to prevent the casting from shrinking as it becomes cool. In either case when the copes are employed they are what is known in the foundry as *flatbacks*. They can be rammed by hand on a flat plate, or squeezed or bumped on a simple power squeezer or jarring machine at little expense either for time or labor.

Living Costs Decrease

The cost of living among wage earners in the United States fell 4.4 per cent during the month of February and was 68.6 per cent higher on March 1, 1921, than it was in July, 1914, as against 76.3 per cent higher than the 1914 base on Feb. 1, 1921, according to figures compiled by the National Industrial Conference board. There was a drop of 35.9 points, or 17.6 per cent between July, 1920, the highest point reached since 1914, and March 1, 1921.

"It should be noted, however, that the percentage of decrease from a higher to a lower base is always less than the percentage of increase from the same lower base to the same higher, although the change in index points is the same in both cases," says the board. "Thus, while a drop of 35.9 points from an index of 204.5 to an index of 168.6 represented a decrease of 17.6 per cent, a rise of 35.9 points from 168.8 to 204.5 represents an increase of 21.3 per cent. In the same way the drop of 4.4 per cent from February to March represents a corresponding increase of 4.6 per cent.

"The continued downward movement in the cost of living during February was due largely to the big drop in the cost of foodstuffs as shown by the bureau of labor statistics index numbers of retail food prices. Average clothing prices declined slightly although there was an increase in the cost of a number of items in the women's clothing budget. Average rents remained stationary; the cost of coal and of certain sundries dropped while average rates for light advanced."

Will Make Auto Castings

The Clinton Stove Co., Clinton, Ind., has entered into a contract to make many of the casting parts for the Ford Motor Co. This new branch of manufacture was taken on for the purpose of making it possible for the Clinton plant to operate when the stove business is dull.

The Bacharach Industrial Instrument Co. recently has occupied a new plant at 7006 Bennett street, Homewood station, Pittsburgh.

Hollow Ware Made in an Old Shop-II

Grinding Operations in the Manufacture of Cast-Iron Utensils Require Flexible Machines that Will Permit the Wheel to Follow the Casting Surface

BY FRED B. JACOBS

AFTER the castings are shaken out, they are snagged to remove mold marks. This operation is performed on carborundum wheels, 16 inches in diameter, 2-inch face, 36 grit, G grade, operated at a peripheral speed of 5000 feet per minute. The reason for using a comparatively fine and hard wheel is to overcome the tendency of the thin edge to promote excessive wear. Thus, snagging hollow ware is essentially an edging operation which always necessitates comparatively fine and hard wheels. After the castings are snagged, they are rattled in tumbling mills to remove excessive sand as was described in the previous article.

The next step is to grind the inside. This accomplishes three results. First, it imparts a smooth surface that is readily cleaned; second after the surface is ground, any imperfections in the molding are readily seen and third, the neat appearance imparted to the article by grinding and polishing aids in the display of the goods for sale.

In the early days of the hollow ware industry, grinding was unknown and these utensils were used just as they came from the foundry. Smoothness was imparted only by use, through countless applications of the housewife's stirring spoon and dish cloth. After the introduction of emery wheels, over 50 years ago, hollow ware was ground by holding the article in the operator's hand and bringing it in contact with the wheel. As may be imagined, this was a slow and costly operation.

The machines used for hollow ware grinding by the Wapak company are of the type designed by the Philip Smith Co., Sidney, O., about 44 years ago. Owing to their early design and their efficient operation when production figures are considered, they are of more than ordinary interest to the manufacturer.

Referring to Fig. 1, *A* is the base which is mounted on legs to elevate the machine a convenient height from the floor. The carriage, *B*, holds the wheel head slide, *C*, by V-shaped ways, one of which is fitted with a gib to take up wear. The wheel spindle is located in two boxes, *D*, which are placed far apart to avoid the tendency of the spindle to chatter and to accommodate the long pulley, *E*, driven by the belt, *F*, from an overhead pulley. This spindle revolves at a speed of 1300 revolutions a minute. The work to be ground, usually, the frying pans, *G*, is held back against the face plate, *H*, by four dogs, *J*, which are compressed toward a common center through the action of the hand wheel, *K*. The spindle carrying the face plate is driven at a speed of 236 revolutions a minute by the pulley, *L*, which in turn is driven from a countershaft, *M*, under the machine. This countershaft is driven by an overhead belt, *N*. The work spindle head, *O*, swivels so that it can be set at an angle. The pillar, *P*, which carries the work spindle head is fulcrumed at its lower end, its radial movement being guided by the plates, *Q*. These plates are integral with the casting, *R*, so that the whole mechanism that moves the work radially can be set at an angle

FIG. 1—GRINDING THE INSIDE OF A FRYING PAN ON A SPECIAL GRINDING MACHINE

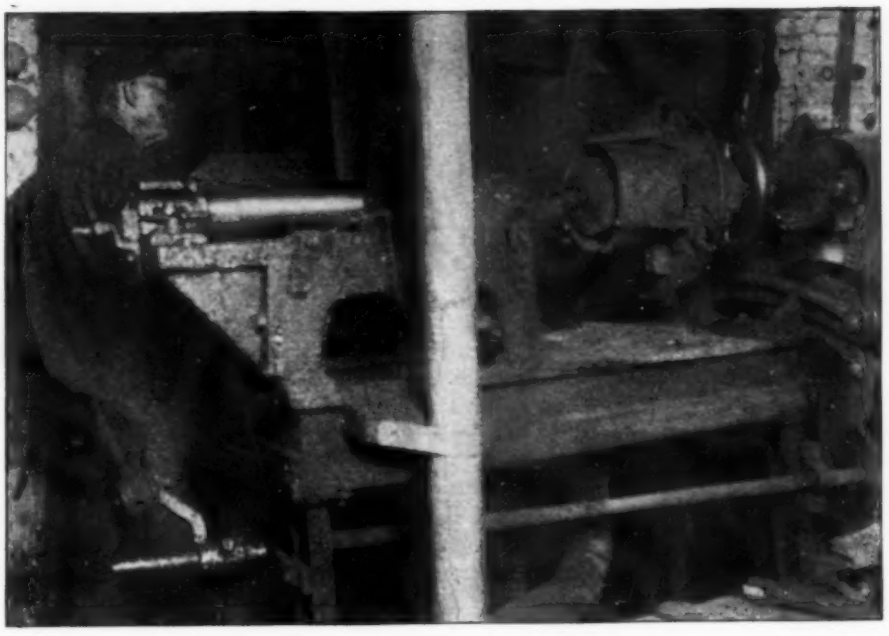


FIG. 2—GRINDING THE INSIDE OF A CAST IRON KETTLE—NOTE THE CLAMPING DEVICE WHICH IS EMPLOYED

The work head is moved radially by the lever, *S*, the link, *T*, the shaft, *U*, and the handle, *V*. Dust is carried away by the exhaust pipe, *W*.

Involves Simple Principle

The principle involved in hollow ware grinding is readily understood by referring to Fig. 5, where a frying pan, *A*, and kettle, *C*, are shown. By setting the travel of the grinding head at an angle, as previously described, the bottom of the article can be faced and the side ground.

At *B*, Fig. 5, the operator starts the cut at the center, *F*, and feeds the wheel by the handle, *V*, Fig. 1, to the point, *G*, Fig. 5. Then the wheel head is fed back by a hand wheel not shown in Fig. 1, until it has traversed the surface *H*, Fig. 5. The angle at the side of the utensil to be ground determines the number of degrees to set the work head over. At *C*, Fig. 5, a round bottom kettle is shown. In both *A* and *C* Figs. 5 it will be noted that the lines *D D* and *E E*, representing the sides of the work and the axes of the wheels are parallel. However, in kettle grinding a wheel technically termed a pot ball, is used. A cross-section of a pot ball is illustrated in Fig.6. It is attached to the spindle by a coarse pitch thread which was molded in the wheel when is was in a green state before vitrifying. Pot balls are made in a variety of shapes to suit various kinds of hollow ware.

By referring to Fig. 1, which illustrated the grinding of a frying pan, it will be noted that the operator sometimes utilizes the weight of his body to feed the work past the wheel. After the work is located in position it is ground, as previously explained, with a wheel technically termed a skillet wheel; it is crystolon, 8 inches in diameter, 1-inch face, 30 grit, R grade. The diameter of the frying pan shown in Fig. 1 is 10 inches at the bottom; 1/16-inch of stock is removed in grinding while the operation takes 2½ minutes. In grinding hollow ware, the principle involved is to take a deep cut, removing the superfluous metal at one operation, if possible. In some instances it is necessary to take a second cut if the piece is not ground out smoothly. Therefore, a hollow ware grinding machine must have some flexibility to enable the wheel to follow the irregularities of the rough casting. If tested with a straight edge, the bottom of a frying pan will show high and low spots that have been ground to a smooth surface. On the other hand, if the wheel travel of the machine did not provide for a certain amount of flexibility, an excessive amount of metal would have to be ground from the bottom of a pan to obtain a true surface.

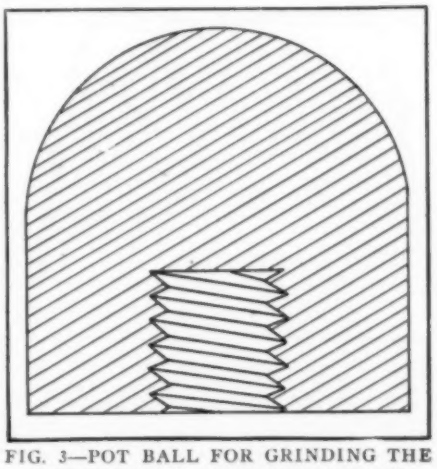


FIG. 3—POT BALL FOR GRINDING THE INTERIOR SURFACES OF HOLLOW WARE CASTINGS

Involves Three Operations

The finishing of grinding pans involves three operations. After grinding, the pan is polished with a setup canvas wheel which is substituted for the grinding wheel. The wheel is coated with No. 60 emery. The next operation consists of buffing with a canvas wheel setup with emery flour. Oil issued on the wheel.

After polishing the pans are *lipped*, as shown in Fig. 3. In this operation, a small, conical setup wheel is used, coated with No. 120 emery. The purpose of this operation is to polish the

FIG. 4—FRYING PAN LIPS ARE POLISHED WITH EMERY ON A SETUP WHEEL

pan lips. The work is held by hand as the illustration shows. As it is necessary to remove only the scale and to impart a bright finish, the production time is rapid, one minute for two lips. As Fig. 3 shows, an exhaust pipe is located over the wheel to carry away abrasive dust.

The operation illustrated in Fig. 2 shows the method of grinding a 10-inch flat bottom kettle. The machine used is the same as that previously described, it is equipped with a carborundum pot ball, 30 grit, G grade, 5 inches in diameter, 5 inches thick, with a 2½-inch radius at the bottom. The pot ball is operated at a speed of 1300 revolutions a minute while the work speed is 236 revolutions a minute. The grinding time for the removal of approximately 1-16-inch of stock is five minutes. Kettles are not buffed as the final operation consists of polishing only, a canvas setup wheel being used.

For finishing sad irons, two disk grinding operations are involved, facing the bottom and the sides. In Fig. 4 the method of bottom facing is shown. The operator at the right is grinding a large tailor's iron while at the left an ordinary sad iron with a detachable handle is being ground. In both instances the work is held in a cradle that is attached to the swing table. Pressure is exerted by the lever at the right. The machine used is a Gardner disk grinder equipped with carborundum disks, 24 inches in diameter, 16 grit, operated at 1136 revolutions a minute. Approximately 1/32-inch of metal is removed by this operation. In grinding the sides, the work is located in a special cradle, the table being set to impart the desired angle. The average grinding time for both facing and edging is one minute for each operation. After grinding, the irons first are polished with No. 80 and then with No. 120 emery, on setup wheels. Irons that are to be nickel-plated receive an additional buffing with oil and emery flour.

Before disk grinders were installed, sad irons were faced in a special lathe equipped with six headstocks. When the bottoms of the irons were machined, it was necessary to leave a liberal allowance for finishing so that the tool could get under the scale. In disk grinding, the principle involved is to start at the scale and work in, feeding the work directly against the disk. Thus the grinding allowance necessary is only great enough to remove the irregularities, leaving a smooth surface. Where sad irons are finished by grinding, a comparatively hard grade of iron that takes a high polish can be used. These irons operate easily as the hard nature of the metal reduces friction to a minimum.

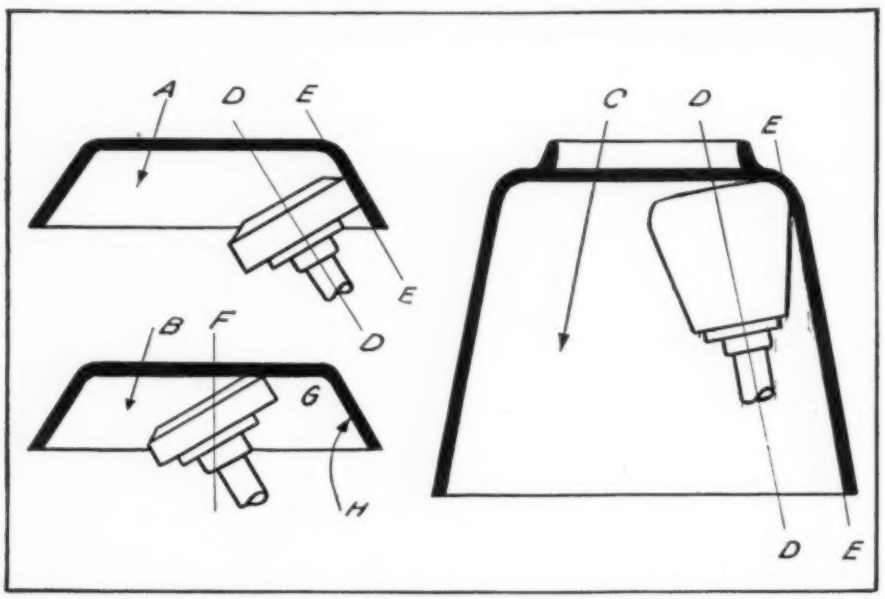


FIG. 5—OPERATING PRINCIPLES INVOLVED IN GRINDING AND FINISHING HOLLOW WARE

Purchases Capital Stock of Molby Company

The Iron Products Corp., 90 West St., New York, recently has purchased the capital stock of the Molby Boiler Co., Inc., 101 Park Ave., that city. G. A. Harder, president the Iron Products Corp., has been elected president of the Molby company, R. R. Rust has been made vice president and Steven Barker, secretary treasurer under the new organization. C. C. Molby will continue as sales manager for the new company.

Discounts Pessimism in Automotive Lines

Although the saturation point of automobile ownership in proportion to population in the United States virtually has been reached, there has been no over-expansion of the automobile industry as such and extreme pessimism over the outlook is not justified, Col. L. P. Ayres, vice president of the Cleveland Trust Co., and noted statistician, told members of the Foundry Equipment Manufacturers' association at their monthly meeting in Cleveland recently.

Col. Ayres said that careful computation established that the average life of an automobile is five years, a consideration of great importance in estimating the probable replacement demand for cars. He predicted that the most drastic contraction in automobile consumption would come in 1923, which would be five years after the war restricted production of 1918. In that year only 1,153,600 cars were made and the replacement demand in 1923 would be correspondingly small.

Discussing the 1921 outlook the banker declared that estimates that the automobile industry would produce no more than 40 per cent of the 1920 output of 2,241,000 cars were too low. He said:

"Instead of 40 per cent I believe that production this year will exceed 60 per cent. Consumption of cars should run as high as 80 per cent of the 1920 output, since it is probable that the demand this year will absorb all of the year's output as well as the something like 13 per cent of the 1920 production which was carried over. An 80 per cent consumption of cars would mean a total of 1,792,800 purchased compared with 2,241,000 produced in 1920.

Activity of the automobile industry is on the mend according to Col. Ayres. This stimulation is not being reflected to any great extent in the industries supplying automobile producers with materials, he said, because of the large inventories of raw materials carried over by the latter. Because of curtailed spending power of the public this year, he predicted that the most popular priced cars would experience the best sales. Further price readjustments might be a development in the industry before the end of the year, he said.

The Connellsville Foundry, Machine & Steel Casting Co., main office and works at Connellsville, Pa., removed its Pittsburgh sales office from 404 House building to 1212 Park building, that city.

Die-Casting Methods and Metals-I

Advantages and Limitations of Die-Casting Are Discussed and the Development and Present-Day Practice Are Outlined—First Die-Casting Machines Used for Lead-Tin Alloys Only

BY M. H. POTTER

DIE-CASTING machines for making type, which were the forerunners of the modern die-casting machines, were built in this country over seventy years ago. The modern industry is about thirty years old and came with the advent of quantity production of mechanical devices and machines.

The origin of modern die-casting practice may be traced to the development of the die-casting machine. Such machines were built in this country as far back as 1838 and were used for lead and tin alloys only.

In 1885 Mergenthaler brought out his linotype machine, and it was the ease of operation and precision with which this machine cast type that suggested the use of a similar machine in casting machine parts out of zinc alloys which have fusing points ranging only about 200 degrees Fahr. higher than type metals, and are much stronger and harder.

It is a fundamental principle that accurate castings of high-fusing metals cannot be made in commercial quantities without the application of pressure and the use of metal dies.

The distinction should here be pointed out between the die-casting process and the American application of the French Clothias process, in which various nonmetallic molding compositions are used. These molds are finer and more substantial than sand and may be used from two to upwards of 20 times depending on the part cast and the accuracy required. The molds are made from patterns and the metal is poured by gravity. Each time the mold is used it becomes less accurate and no moving parts or permanent cores may be used.

All die-casting processes, as the term is generally understood today, employ a compression chamber, in some form, in which the metal is subjected to pressure while liquid, and from which it is forced into metallic dies. This chamber may be large enough to hold sufficient metal for only one casting or for a great number.

Various methods of applying pressure have been used. Type casting machines employ a piston traveling in a cylinder and this method has proved satisfactory in casting metals melting at 950 degrees Fahr. or less. Compressed air is widely used and is generally adopted when the fusing point is above 950 degrees, as under such conditions a plunger cannot be operated. In modern dental casting machines explosive gases are used and in some European processes explosives in the form of cartridges furnish the necessary pressure. Centrifugal force has been employed especially in dental work by spinning the metal chamber and die and then opening a valve which permits the metal to rush into the mold. This process is slow and can be used only for small parts. It produces solid castings but is impractical for general commercial application. Iron piston rings are being successfully cast in this manner. A compression chamber is not used, but the metal is poured into the center of a rapidly revolving die which is formed of cast-iron discs.

Difficulties Are Encountered

Although the plunger construction has proved serviceable it involves many difficulties, especially when zinc alloys are used. If the plunger is fitted close to the cylinder to secure good compression it frequently sticks, due to unequal expansion and warping. Sticking is also caused by dross which becomes wedged between the plunger and cylinder, forming a sandy mass of oxides and metals which alloy with the iron, sometimes practically brazing the plunger to the cylinder. When this occurs the pumps must be removed and the plunger drilled or cut out. If on the other hand the plunger is loose, the necessary pressure can not be obtained. When plungers are well fitted they may sometimes, with care, be operated as long as a month before they become worn too much for use. Plungers cannot be left at rest in a cylinder for any length of time and must always be removed when the machine is not in use, as otherwise they will stick or solder to the cylinder and must then be machined to get them out.

Compressed air is objectionable for use with metals that have a tendency to dross excessively, and it is difficult to keep tight joints at the temperatures and pressures needed for die-casting. These objections can be minimized by ingenuity in design, and at temperatures over 950 degrees Fahr. compressed air is thoroughly practical and efficient if properly applied.

The pressure chamber is connected directly to the die carriage by means of a nozzle. Pressure chambers must be made from metal as no other known substance will carry the required pressures at the casting temperatures of the metals die-cast. Cast iron is almost universally used for this purpose, but malleable iron is also used to some extent. Steel is attacked more readily by molten metals and has not been as satisfactory.

The die may be in any position with relation to the pot. On some machines the pot is raised and the die is operated underneath it. This requires the use of a valve to shut off the metal when the die is removed. In other cases the die is on the side of the pot, which also requires a valve to retain the metal in the pot. When the die is placed above the level of the pot no valve is needed, but then the metal must be forced upward into the die, which by some authorities is considered inadvisable. It is no doubt better to let the gravity assist instead of hinder the casting operation, but the use of valves involves so many troubles and objectionable features that working against gravity is by far the lesser of the two evils. Except for use at comparatively low temperatures no valve has yet been made which will operate satisfactorily in molten metal, due to the wear and the action of the metal in eating away the surfaces of the valve.

In some machines the metal chambers tilt. Either the entire pot of metal is tilted or a small chamber is immersed in the pot. In one case the pot is mounted on brackets with the die above it. When the casting is made, pot and die are turned upside down and then the pressure is applied by compressed air in the pot. It is claimed that by this process the metal enters the dies by gravity and that the pressure in the pot is only applied when the die and gate are filled with metal, the pressure merely densifying the casting. The fallacy of this is ap-

The author is indebted to the Precision Castings Co., Syracuse, N. Y., for the information contained in this article.

parent to anyone who has tried to pour metal into a die by gravity. The metal chills almost instantly and before it has passed out of the gate in many cases. The moment the metal chills it stops the flow and no amount of pressure will fill the mold. To make a die casting the pressure must be applied to the metal before it enters the die. The finish and accuracy of the casting will be largely dependent on the speed with which the metal enters the die. If the speed of the inrushing metal permits it to fill the die faster than the die can chill the outer layers of a body of metal of that shape, a good casting can be made; otherwise the casting will show heavy ridges, run marks, etc., and the impression in the die will not completely fill it. The revolving of a large pot and heavy die is slow and the metal in the pot is pretty well shaken, the very thing which is disclaimed for the process. It would seem that a simpler and more direct method of forcing the metal into the dies could be used, with resultant increase in production and less wear and tear on machinery.

In some processes a vacuum is used to exhaust the air from the die cavity just before casting, and it has been asserted that denser castings can be produced by this means. The best results obtained have never justified the claims made for the vacuum processes.

In some castings the flow of the metal has a tendency to collect bubbles at certain points. The same result may be noticed when water is forced rapidly around a sharp corner. A bubble will cling to the corner no matter how great the speed of the water. This is caused by the change in direction of force, the heaviest particles of matter being carried the farthest away from the corner, the lightest pass nearest the corner. In addition, a partial vacuum is formed by the tendency of all the particles of matter to continue in the same direction, and the air and gases are drawn from the water into this vacuum. The same thing is noticed when an object is moved rapidly through water, a vacuum is formed directly behind the moving object, into which a certain amount of air and gases normally present are drawn.

It is the same condition which is frequently responsible for blow holes at certain points in die castings, and it is apparent that the difficulty is not overcome by casting into a partial vacuum. However, it is possible in most cases to overcome conditions of this kind by changing the size and direction of the gate, or its location.

If the die is properly vented and gated, the pressure of the inrushing metal will force out all the air instantly and a vacuum is unnecessary. Even if a little air should stay behind it would not be the cause of porosity in a casting. Castings are made at pressures ranging from about 20 to 70 atmospheres. In other words, if a casting were made in a hermetically sealed die, only about 1-20 or 1-70 of the volume of the cavity would be air. Under ordinary conditions it would be impossible to make a casting in a die from which less than about 95 per cent of the air has escaped. Therefore, the ordinary casting made with the usual pressure would contain only ¼ to 1¼ per cent of the original air of the die cavity by volume. This could not be sufficient to affect the strength of a casting perceptibly as it would be distributed through the casting.

Troubles With Vacuum

If the vacuum is not shut off the moment the metal enters the die, the sucking action of the vacuum has a tendency to draw or suck the metal to the air vents, sealing them and thereby producing a condition much worse then if no vacuum were used. Diaphragms have been used to balance the vacuum in the die against a vacuum in the metal chamber, but this only prevents sucking of the metal into the die before pressure is applied to the compression chamber. The best evidence after all is the result, and in this no vacuum process has shown any improvement in product over the applied and successful processes in which no vacuum is employed. It must also be borne in mind that conditions about a casting machine are such that a high vacuum cannot be maintained due to the heat, chips, fires, dust and dirt, etc., constantly present.

The dies are generally mounted on a carriage on which they are opened and closed. The carriage is usually in the form of two plates to which the dies are bolted, and the plates slide on two or four bars. This carriage is attached to the frame of the machine, either rigidly or on a hinge in such a manner that the dies may be swung away from the nozzle through which the metal passes, to permit ejection of castings and cleaning the die and nozzle.

The general practice is to open and close the dies by hand by means of toggles, and to hold the die carriage to the nozzle of the machine with clamps which are also operated by hand. The pumping, in plunger machines, is also generally a hand operation. Hand operation die carriages cannot be made strong and substantial enough, except for very light castings, to give the best results, due to the weight of large dies and the great pressure of the metal entering the dies. Great strength and endurance is required in operating the dies for casting and it is therefore difficult to keep high class labor at this work, except at prohibitive wages. Low grade labor cannot be used to produce good work and causes much loss by the production of cracked and defective castings.

The difficulty in applying power to die-casting machine operation has been the varied character of the dies which must be used and the necessity of holding the dies closed under high pressure. The mechanical action of a press of any character, for instance, would be entirely unsuitable. It has been difficult to adjust casting pressures and speeds mechanically to the requirements of different dies and it seemed at one time almost impossible to construct a die carriage which could be operated mechanically and which would not involve too much time and trouble to adjust it to any die that might in the usual course be used. Power driven and automatic machines for use in connection with tin and lead alloys for small and comparatively simple parts have been in use for some time but are not practical for general use with high fusing metals.

Two methods of feeding the metal into dies are employed. In the one the metal is introduced between the die surfaces. With this method the nozzle through which the metal enters the dies is at the parting line of the dies. In the second method the metal passes through the lower die-block opposite the ejector side, in which case the nozzle through which the metal enters the die is at right angles to the parting line. In the latter case a sprue cutter or gate former is needed.

The gate former is usually a tapered bushing attached to a handle, which is placed into the die for each operation. It is set between the die and the nozzle of the casting machine. After the casting is made the gate former is turned, usually on a cam, so as to lift it out of the die. At the same time it breaks off the sprue or gate to permit ejection through the die block.

The sprue cutter is simply a rod which passes through the die into the gate through which the metal enters the die. When the casting is to be made the sprue cutter is raised free of the gate and the instant the die impression has been filled the sprue cutter is pushed into the gate, closing it and cutting off the flow of metal. This facilitates the removal of

the sprue from the die and prevents the metal from running out of the die before it sets should the pressure be released. It also makes it possible to gate through a hole in the casting or into its side without having a gate or sprue on the casting as it comes out of the die. A certain amount of skill and experience are needed to operate sprue cutters, as they must be operated at the instant the die is filled. A fraction of a second early or late may spoil the casting.

Sprue cutters wear more than cores and are therefore not so accurate when they are used to form any surface of a casting.

Inasmuch as a sprue cutter cuts off the flow of the metal, it cuts off the pressure, and the moment the metal contracts it is no longer under pressure. The beneficial effect of the pressure then is lost on the unsolidified parts of the casting and, most important of all, it is not possible to feed in metal to make up for the contraction of the casting. This tends to make the center of a heavy part porous and spongy and also affects its accuracy, as the shrinkage will not be so great when additional metal is fed into the casting under pressure to make up for its contraction in cooling. However, lighter parts do not show any appreciable difference when made with or without a sprue cutter.

The inherent limitations of the die casting process in its present development are such that only certain adaptable metals may be used, and when the particular strength and qualities of steels and bronzes are required, die castings cannot be substituted for parts made of those metals.

More Accurate Than Drawing

The process is more accurate than punching or drawing sheet metals because there is not the same wear on the dies, nor is the spring and distortion of drawn metal a factor. Forgings or pressed steel parts are not as accurate as die-castings and cannot be produced in as wide a range of design.

The degree and range of accuracy which may be held depends first of all on the accuracy with which the die is made. The die is virtually a gage which fixes the size of each part cast from it. The size and design of a part and the metal used also affects its accuracy. Small castings can be held closer to dimensions than large ones. Castings having an odd and complicated design sometimes shrink irregularly. Most of the shrinkage takes place after the castings leave the die. In large castings the die temperature, if permitted to vary materially between operations, as well as the temperatures at which the metal is cast, will affect the accuracy of the part.

Die-casting machines can be made to meet these difficulties. They are so constructed that proper temperature regulation of the die, machine, and metal is easy. The operation of the machine is regular and constant. The position of the dies on the machine, as well as the method of operating and cooling them, all help to keep casting conditions uniform, which in turn affects the flow and finish of the metal as well as the shrinkage. Accuracy is of course also affected by cleaning operations and removal of gates.

Compressed Air for Cleaning Die

Dimensions across the parting line of dies are more difficult to hold to close limits, because it is almost impossible to keep the die surfaces absolutely clean. Compressed air under high pressure is used to clean all particles of dirt and metal from the die surfaces. The pressure used in casting also has a tendency to force the dies apart. In most cases an accuracy of from plus .002 to plus .004 inch across the parting line can be maintained.

To a more limited extent there is a certain amount of inaccuracy in those parts of castings which are formed by slides or other moving parts in the dies, as dirt or particles of metal sometimes prevent the slides or cores from going completely home. There must also be a certain amount of freedom in such parts to permit easy operation. However, by close and accurate workmanship, great accuracy may be maintained.

Holes in which a close fit is needed, that is, less than a variation of 0.001 inch, should be reamed, and stock should be allowed in the casting for this process. When parts are to be ground, about 0.005 inch should be allowed, and when machining is to be done, about 0.010 inch.

All holes in walls from which slides or cores must be horizontally withdrawn, or which in ejecting rub die surfaces, must be tapered, except in soft tin and lead alloys. Without taper the die will rub the casting, causing it to chip and crack. When the parts leave the die they are so hot that they are still very frail, and slight pressure will fracture them. As much taper as possible (from 0.005 to 0.0010 inch or perhaps more per inch) should be allowed, as this allowance reduces cost by increasing production. The following table will show the smallest amount of draft with which practical results in average cases can be obtained:

Hard tin and lead alloys.....	0.00025 inch
Zinc alloys.....	0.0025 inch
Aluminum alloys	0.003 inch

Extreme accuracy in every dimension is expensive because it greatly increases the time necessarily spent on die work. Close or particular sizes should therefore be specified and the accuracy to which they must be held agreed upon. When sizes are specified in fractions instead of decimals it is generally understood that more liberable limits are permissible.

When the dies are first made for parts that must fit others, it is well to work safely, *i. e.* making the fit loose, then after the first samples are made it becomes a simple matter to determine just how much metal to add to the casting to make the fit right. If the fit should be too tight new cores or parts in the die would have to be made, as the change involves adding metal to the die surface.

The elimination of error by avoiding the *human-variable* is accomplished in die castings to a great extent. The die is virtually a gage, and the size of the castings is in no way dependent upon the will or discretion of the operator. Consequently die castings are interchangeable, which offers well understood advantages in manufacture and assembly, and in making replacements for broken or worn parts.

A die casting, unlike a sand casting, has a perfect finish over its entire surface, which is smooth and clean cut. The excellence of the finish is largely dependent upon the process used in manufacture, and upon the care and attention given the work. With exceptions, the practical limit in weight is about 10 pounds in the zinc-tin alloys. The size seldom exceeds 24-inch over all.

Costs Lowered

It frequently happens that two or more parts which must be produced separately and assembled by other processes may be combined in a single die casting. The result is greater accuracy, lower cost, better appearance, and generally greater rigidity and strength, with no opportunity for the separate parts to get out of line or adjustment.

When assembling cannot be avoided for individual pieces, the parts may be so designed that the work of assembling is much simplified. This is done by making the parts lock into each other in such a manner that they cannot lose their adjustment and can readily be located in the proper position. For this purpose dowel pins

on one part and corresponding holes in the other, or keys and keyways, tongued grooves, square holes, interlocking lugs, etc., may be cast. Of course, the uniformity and accuracy of die castings alone make assembling easy and inexpensive.

Die castings are sold at a price per piece or set of pieces, and the dies are the subject of a separate charge. The factors of cost considered are as follows:

Weight.
Kind of metal used.
Quantity ordered in one run or setting of dies.
Total quantity ordered.
Casting production per hour.
Cleaning operations required.

All things considered, a die casting, when suitable, usually presents a cost advantage, but they are not always used for that reason alone. Intricate parts requiring a great deal of skill in machining and finishing usually present a large saving. The die-casting process, generally speaking, is more expensive than sand casting, and for that reason castings, which when made in sand molds may be used without machining or finishing operations, cannot be die-cast to advantage. No idea of the cost of particular parts can be given as this depends on the weight, design and quantity ordered, as well as on the die equipment. In considering the cost of dies it must not be forgotten that they offset the investment usually needed in other processes for jigs, patterns, fixtures and special tools. Furthermore, dies are not subject to the wear and tear and deterioration of other tools, as they are kept in perfect working condition by the firm which makes the castings.

It is frequently advisable to do machine work on die castings when the machining operations are inexpensive and the work of die casting is thereby made simpler and less expensive. This is true of inside threads in most cases, and some times of inside grooves, undercuts, slots, etc. Where machine work is done it is simpler and cheaper than the same work done on sand castings, due to the uniformity of the die castings, and the ease with which they may be located in jigs and fixtures. When holes are to be reamed on surfaces ground or machined, less stock need be allowed and a lighter cut taken, due to the accuracy of the castings.

Die castings are not always cheaper than the same parts produced by other processes, as the production of casting machines is not high compared with screw machines or presses. A casting machine, to run efficiently, requires two operators and represents a high daily maintenance cost for power, fuel and metal losses. Die casting is beneficial principally in reducing the labor cost of non-automatic manufacturing operations, such as machine work of any kind, engraving, filing, fitting, grinding, spinning, bending, soldering, assembling.

Setting the dies and getting them started is slow and troublesome work. After the dies are started it takes some time before the men are familiar with them and reach a high average production. For these reasons, the process is essentially a quantity proposition, permitting low production cost in long runs. On the other hand, in small quantities the cost is sometimes much greater than for the same production by other processes. Generally a thousand is the minimum lot, but heavy and expensive parts are sometimes made to advantage in smaller quantities.

Cleaning or trimming die castings after they are made is an important item of cost. The gates must be removed and also the fins which appear around the parting line of the die, in holes, and around the parting line of all moving parts in the die. This work is sometimes difficult and tedious and if carelessly or cheaply done will detract from the appearance and accuracy of the castings or spoil them entirely.

Comparatively light and simple parts, when used in quantities large enough to justify the die cost, may be made in multiple dies running as high as fifty impressions, according to the piece. Due to the pressure and power of the machines and the die construction employed, the use of unusually large dies and the casting of a wide range of combinations in one mold can be maintained. Often an entire machine consists of seven or eight parts in a single combination die, thereby reducing die cost as well as the casting cost, since a combination die of eight parts would not cost as much as two dies of four parts each. When combination dies are made, the parts should always be ordered in sets as it is not practical to make castings out of only a portion.

(*This article will be continued in an early issue.*)

Lime Slag Lowers Sulphur in Cupola Iron

BY A.C. PORTER

OWING to the high sulphur content in all scrap iron, and the desire to use a large percentage of scrap in the mixture for economical and other reasons, the writer has been experimenting with limestone in an attempt to eliminate a part of the sulphur content. Every foundryman knows that sulphur in excess of 0.10 per cent in castings that are machined or put under test will cause hardness, segregation and various other troubles in the machine shop, as well as foundry losses. Therefore the endeavor must be toward a partial control or elimination of this element.

Much has been said of the electric furnace and its use in gray iron foundries, either for direct melting or for duplexing with cupola metal. This furnace gives excellent control of the mixture and the temperature of the metal, as well as eliminating sulphur trouble. However, its use must necessarily be confined to the production of extra high quality iron due to its low tonnage capacity and high operating cost as compared to the cupola.

In seeking a method to calculate the proper flux requirements, it was felt that the method used in blast-furnace practice for burdening the furnace would be firm ground to build on. It has been found that basic slag does not hold much above 2 per cent sulphur. Therefore, the more sulphur to be taken up by the slag, the greater must be the amount of slag formed. The desired ratio of bases to acids is 1.1 to 1. A trial was made with limestone of the following analysis:

SiO_2 (1.76%) Al_2O_3 (1.12%) CaO (54.09%) MgO (0.53%)

The available base in the stone is found as follows:

	Acids	Bases	
$Si O_2$	1.76	54.09	Ca O
Al_2O_3	1.12	.53	Mg O
Total	2.88	54.62	Total
Slag ratio	1.1	3.168	Bases neutralized
Bases neutralized	3.168	51.452	Available base

$$\frac{100.00}{51.452} = 1.91$$ is the efficiency factor of flux

In cupola slagging the important part of the coke is the ash content. The coke used had an ash content of 12 per cent or 12 pounds per 100 pounds of coke subdivided as follows:

SiO_2 (5%) Al_2O_3 (3%) CaO (3%) MgO (1%)

To find the amount of flux required, subtract the total bases (3+1=4) from

The author, A. C. Porter, is foundry superintendent, Witte Engine Works, Kansas City, Mo.

total acids (5+3=8) and multiply by the slag ratio (8—4=4×1.1=4.4).

This product is the amount of acids needing to be neutralized by the stone, so by multiplying by the efficiency factor of the stone, the pounds of flux required per 100 pounds of coke is found. Thus 4.4×1.91=8.4 pounds of limestone for every 100 pounds of coke used.

Considering the sand adhering to the sand-cast pig iron, it was estimated that there is approximately 40 pounds of silica (SiO_2) per ton of pig. Multiplying this by the slag ratio and then by the efficiency factor of the stone it is found that 40×1.1×1.91=84. Thus 84 pounds of limestone are required for every ton of pig iron. The amount of limestone to neutralize the acids of the scrap will vary according to whether the returned iron is cleaned or not cleaned. Allowance must also be made for the silicon and sulphur from the metal which go into the slag. No set rule can be applied to accomplish the desired result in each and every plant, but by using the method as outlined any condition can be overcome.

Limestone amounting to as high as 70 per cent of the coke charge has been added to the cupola with beneficial results. With a high temperature attained by correct cupola melting conditions, no difficulty is found in drawing off the large amount of slag formed. The more slag with the proper slag ratio the greater is the amount of sulphur taken up by it. By using limestone to reduce sulphur the manganese that would otherwise form manganous sulphide is released and consequently retained by the iron. In an experiment, where the metal before an attempt to flux was made had 0.54 per cent manganese and 0.139 per cent sulphur; after adding excessive limestone the result showed 0.71 per cent manganese and 0.093 sulphur. The writer firmly believes that judging from the results obtained in the preliminary tests it is possible, by farther experimenting along these lines, to overcome the high sulphur menace and to hold it under sufficient control to eradicate the troubles that are otherwise apt to come.

LIMESTONE IS USED IN THE CUPOLA TO THIN THE SLAG BUT HAS NOT COME INTO GENERAL USE FOR LOWERING THE SULPHUR CONTENT OF THE METAL

Great care must be exercised in determining the location of the slag hole and in the method used for opening it when ready to draw off the slag. A method which has worked successfully is as follows: Select a short piece of pipe of the desired diameter and after it is wet with clay wash and set in the slag hole, pack stiff clay into the opening between the pipe and the lining, after which withdraw the pipe, leaving a clean hole, which is then dried. From the inside of the cupola ram heap molding sand into the slag hole, flush with the inside of the hearth, thereby eliminating any possibility of iron or slag freezing. The heat from the bed dries the sand so that when the crust is broken with a bar it crumbles away leaving an efficient slag hole which can be plugged after slagging. It is necessary to retain an excessive amount of slag in the hearth during the heat to obtain the removal of the maximum amount of sulphur. It might be advisable to add that a foundryman undertaking this must understand scientific cupola practice, otherwise the results are apt to be discouraging.

Applying Engineering to Foundry Work

BY ALFRED W. BOWIE

DURING the last ten years, and more particularly during the war period, the necessity for increased production in all lines of manufacture, the higher wages paid to workmen, and the demands of labor for better working conditions have resulted in a tremendous amount of remodeling and reconstruction of manufacturing facilities and the construction of plants to house new industries and to replace those which, on account of their nature and arrangement, could not be economically remodeled. In this reconstruction and expansion industrial and constructing engineers have borne a large part.

It is realized that the work of the industrial engineer embraces a wide field. It includes the study and analysis of manufacturing processes; the proper layout of plant to co-ordinate departments; the routing of materials through the plant; the handling of raw materials and finished products; the providing of satisfactory methods of lighting, ventilation and sanitation, and the economical production and use of power. All these are important factors in making a satisfactory and economical product.

After determining the layout to provide for a satisfactory and economical manufacturing process, it has been the work of the constructing engineers to build satisfactory structures to enclose the manufacturing processes. It is necessary to use such materials as best meet the conditions in the location at which the plant is placed, and to fit this construction to the limitations that always exist as to cost, labor conditions, state of the market for building materials, and proper de-

Abstracted from a paper presented by Alfred W. Bowie at a meeting of the Philadelphia Foundrymen's association. The author is an engineer for Dwight P. Robinson & Co., New York.

sign of buildings to meet operating requirement for light, ventilation and heating.

This close relationship between industrial and constructing engineers has resulted in a great advance in the modern manufacturing plant. To this co-operation, aided by efficiency engineers has been due, to a great degree, the increase in the production and efficiency of such plants.

We all realize that efficiency engineering, industrial engineering and all other similar forms of engineering can be overdone. While much good work has resulted from their work, much has been done that is not so good where the experience and knowledge of the engineers responsible has not been broad enough to bring to them a realization of the limitations and the operating requirements in the average manufacturing plant.

Good Engineering Needed

The foundry industry needs engineering for it is unfortunately true that in many ways foundries have lagged behind the other industrial plants. Too often we see foundries housed in buildings located with no particular reference to anything, without adequate light and air, lacking the simplest facilities to economize labor or with facilities provided that do not in any way meet the operating conditions in the plant.

The foundry requires the same analysis of manufacturing processes and the same attention to proper layout and the routing and handling of raw materials and finished products as any other type of manufacturing plant. Further, from its nature a foundry constitutes a more complicated problem than a machine shop or other similar plant. In a foundry the increase in output is not often the limitations of a machine but more the physical limitations of the man operating it.

The amount of raw materials to be handled usually is greater in a foundry in proportion to output than in other plants and on account of the nature of the foundry product and the process of its manufacture the problems of satisfactory light, ventilation and sanitation are more difficult than in other classes of manufacture. The necessity for making a foundry an attractive place to work is present as in other industries, but the difficulty of making it so is greatly increased.

If production costs are to be reduced, it is essential that labor saving equipment be used to the maximum extent that is economical; that processes be so co-ordinated that lost time of labor is reduced to a minimum; that raw materials be handled to the smallest extent necessary and by the cheapest method; that the best possible working conditions be maintained to make the plant attractive to labor. In order that these things may be provided without excess cost of plant and equipment, careful consideration must be given to the refinements of design of buildings and the use of materials that prove the most economical in the locality in which the plant is to be constructed.

The design of a practical foundry, or successful foundry engineering, requires a wide experience in industrial engineering. A full knowledge of the general principles underlying every manufacturing process is needed as well as experience in the design of shop buildings and their service equipments of lighting, heating, ventilation and plumbing. A complete knowledge of building materials and their use in plant construction, experience in power plant design and construction, and a knowledge of the equipment applicable to foundry use, all combined with a first hand knowledge of the problems that confront the foundryman in the manufacture of his product and a large measure of common sense, constitute the attributes of a good foundry engineer.

The foundry engineer cannot hope to combine with these the detailed knowledge of foundry work which every foundry superintendent requires for the simplest foundry operation, but he must know enough of the foundryman's problem to realize his necessities so that with his assistance he can produce a building which will provide him the tools with which to work in an economical and satisfactory manner.

Magnesite Output Shows Large Increase

The production of magnesite during 1920 showed an increase of 94 per cent over that obtained in 1919. California and Washington were the only two states which produced this material and of these, California increased the quantity mined by 63 per cent and Washington by 109 per cent over the preceding year. Washington mined 221,985 tons during the year just past, as compared with only 106,206 tons in 1919. This increase is particularly notable, when it is recalled that the state has been mining magnesite only since 1917. Practically all of the magnesite mined in Washington last year, according to the United States Geological Survey, was dead-burned into synthetic ferromagnesite and used as refractory furnace lining. The accompanying table shows graphically the growth of the industry during the past few years.

The business depression which started during the last few months of the year severely affected the magnesite interests. In Washington, practically all operations were stopped for want of orders. Some of the California producers also were discouraged due to the high costs of production, the high freight rates and the competition of foreign material.

The bureau of foreign and domestic commerce reports 43,154 long tons of calcined magnesite imported during 1920. It is interesting to note that although the quantity of magnesite imported in 1920 was nearly three times as great as in 1919, it was only one-seventh of the quantity commonly imported before the war.

Crude Magnesite Produced and Sold or Treated in the United States

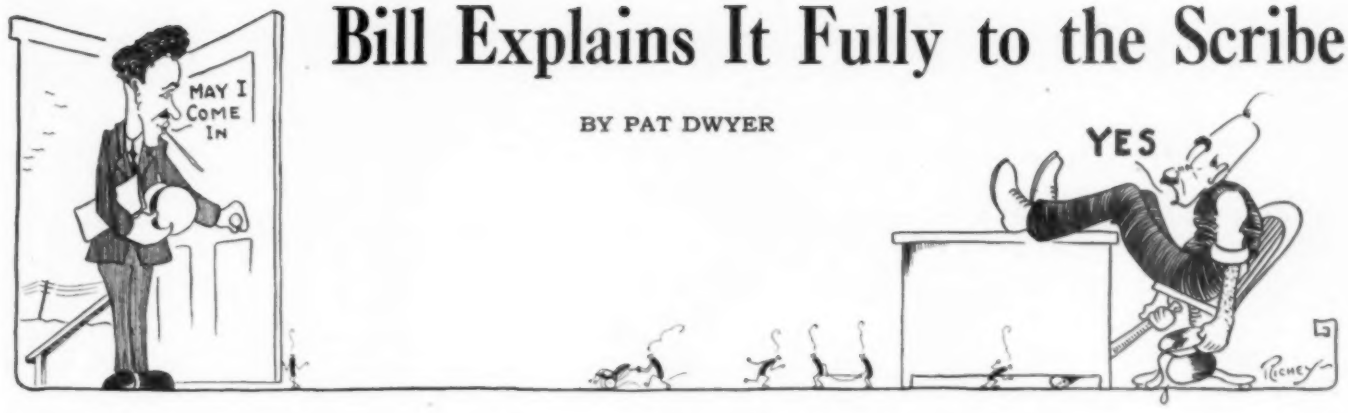
1913-1920

Year	California		Washington	
	Quality (short tons)	Value	Quantity (short tons)	Value
1913	9,362	$ 77,056	...	...
1914	11,293	124,223	...	...
1915	30,499	274,491	...	...
1916	154,259	1,388,331	715	$ 5,362
1917	211,663	2,116,630	105,175	783,188
1918	84,077	761,811	147,528	1,050,790
1919	50,020	504,973	106,206	743,442
1920	81,782	1,083,262	221,985	1,664,888

Palmer Foundry Quits Jobbing Work

When the Palmer Foundry & Machine Co., Palmer, Mass., is ready to begin operations in its new plant, it will abandon jobbing business and make a specialty of making soil pipe and fittings. It will be the only foundry in New England doing this class of work. The new plant which replaces that destroyed by fire a year ago, is fire proof, being constructed entirely of iron, steel and concrete. When ready for operation in a few weeks the plant will have a capacity for turning out eight to ten tons of finished product daily.

The General Electric Furnace Corp., San Francisco, has been incorporated for $25,000 to manufacture and deal in furnaces. E. R. Solinsky, Call building, C. R. Johnson, E. A. Potter and others are the incorporators.



Bill Explains It Fully to the Scribe

BY PAT DWYER

THE other day sitting with my feet cocked up on the desk and engaged in the pleasant occupation of mentally spending next month's salary, I was interrupted by the entrance of a young man who was the absolute last word in sartorial elegance. Once upon a time I should have blushed and felt deeply embarrassed in the presence of so much grandeur, but one of my sons has been buying his own clothes for over a year and I have become acclimated. Nothing gives me a jolt any more.

I removed my feet from the desk and asked the young man what I could do for him. With the air of one conferring a favor he informed me that he was a special or feature writer on one of the daily papers. He had been commissioned to do a series of special articles for forthcoming Sunday editions, dealing with typical manufacturing plants in the city. He had been given to understand that I had had some experience in the foundry business and he felt that I might be of some assistance to him in one of the articles of the proposed series. Not, he hastened to add, in the preparation of the story, the technique and composition and all that kind of thing were only child's play to him; but he never had been in a foundry in all his life and he wished to introduce the local terms and technical allusions to give the article just the proper atmosphere.

"Nothing," he said, "adds so to the value of a story as local color and I always make it a point to steep myself in the proper atmosphere before commencing to write. I absorb the feeling in the air as it were and thoroughly familiarize myself with every phase of the subject."

I assured him that I appreciated the compliment, but I hardly felt competent to do justice to the subject. However, I had a friend who ran one of the largest jobbing foundries in the city and if he cared I should be glad to accompany him and introduce him to this man who I was sure would be pleased to discuss the subject. He said that if I thought we should find my friend in his office he would be glad to accompany me, but that really he did not feel like going into the foundry itself.

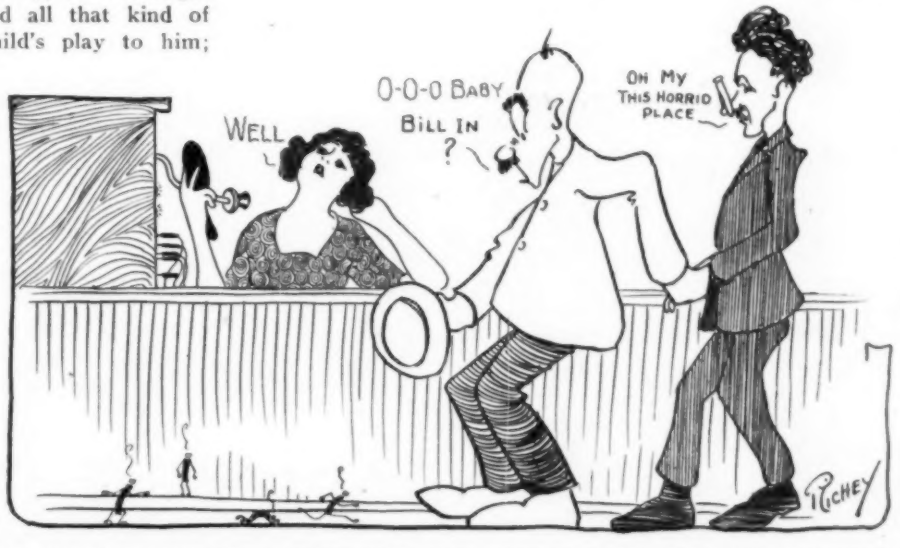
"I frequently have driven past such places," said he, "and I always have noted a strong and disagreeable odor in the vicinity."

I told him I could not guarantee finding Bill in the office and as for the odor I had been in lots of places that smelled worse than a foundry.

I have a speaking acquaintance with the principal people in Bill's office including little Dolly Varden who sits behind the switchboard. She smiled sweetly on our approach, said Bill was out in the shop but the *old man* was disengaged and would see us. The old man regretted that business was slow, the shop was running with only half a crew and therefore not in a position to do itself justice in the eyes of a visitor; but he was sure the young man could gather up considerable information and he could promise that Bill would tell him anything he wanted to know.

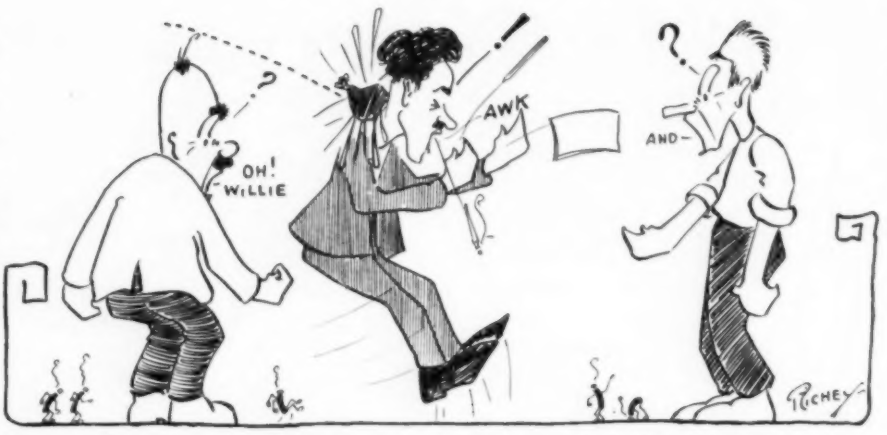
We found Bill standing about half way down the middle gangway watching the crane rolling over a big core. He had an old hard hat known colloquially I believe as a *dip* or *bean bouncer* cocked over one eye. I could see while making the introduction that neither he nor the writer was favorably impressed with the other. The visitor wasted no time in preliminaries but intimated that if Bill kindly would give him, say a 200-word synopsis of the processes employed in making castings he would not trouble him any further. Bill said he would, but he doubted if the subject was worthy of 200 words.

The process as he explained it really was quite simple. First, he conducted us out into the yard and showed us the drop ball for breaking iron. He gravely informed the young man that the iron was exceedingly hard when it arrived from the blast furnace and they had to drop the ball on it several times until it became soft enough to use in the cupola. The process indeed was analagous to that employed in the preparation of a tough beef steak, a homely illustration which he felt sure the young man would appreciate. The relative hardness of



EVEN A DULL AND PROSAIC FOUNDRY MAY HAVE ITS COMPENSATING FEATURES

the castings was determined by the amount of pounding the iron received in the yard before it was melted in the foundry. The process of melting the iron he explained by pointing to the cupola which he referred to as a *boiler*. He said that a large fire was kindled under the boiler which then was filled with pieces of the softened iron. The iron was brought to the boiling point in about 2 hours and then it was drawn off in the iron buckets which he indicated lying around in the vicinity. The buckets were carried to various points on the floor by a crew of specially trained strong men who dumped the contents into the waiting molds.



FOUNDRYMEN APPEAR TO HAVE A PERVERTED SENSE OF HUMOR

He dismissed the subject of making the molds by the general statement that there was *nothing to it*. He admitted that in the matter of making sash weights they enjoyed certain advantages over their competitors in that one of their molders had a wooden leg. This man leveled off a sand bed every morning and then walked all over it poking his wooden stump down at 6-inch intervals until he had put up his required quota of molds. He had become so expert in gaging the distance to drive the stump that he could produce any given weight between 5 and 15 pounds. Furthermore, he was an artistic chap and varied the monotony of the job by stamping the molds in artistic patterns all over the bed.

What further information Bill intended to hand him never will be known for at this point a blacking bag materialized out of no place in particular and came to rest violently on the scribe's neck.

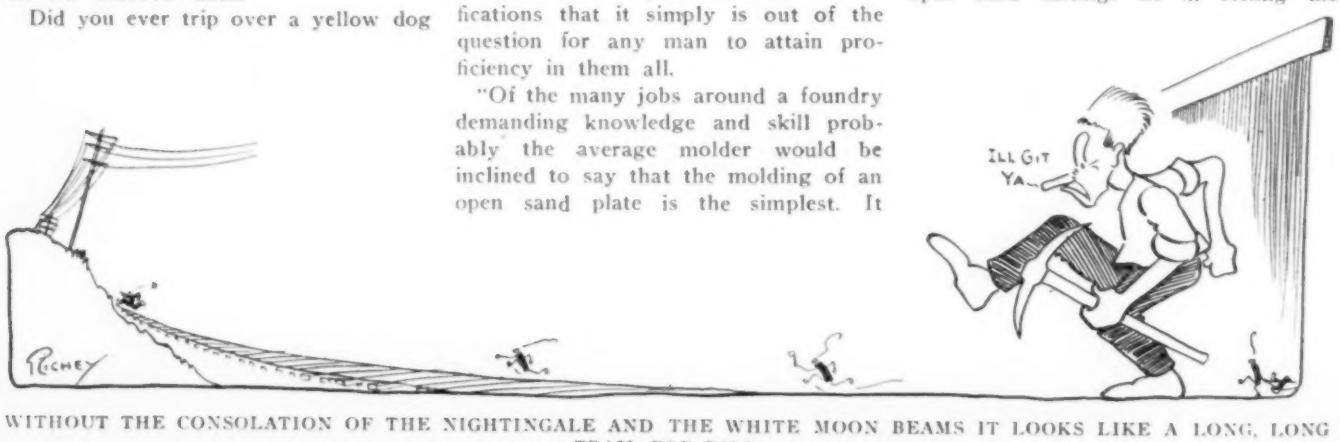
Did you ever trip over a yellow dog in the dark and then give him a kick to ease your feelings? Well, then you know the species of agonized and surprised yelp emitted by the young man as he fled for the door. I made no attempt to overtake him. I am no sprinter and besides I considered that I had done all that reasonably could be expected under the circumstances. I asked Bill what he meant by presenting such a curious and distorted account of the foundry business to this young man who came seeking after knowledge.

"Them kind of birds," said Bill, "make me tired. He did not come seeking knowledge. He knows it all already. Did you hear what he said? 'Tell me all about the foundry in 200 words.' If he had not looked so offensively important and so afraid that a speck of dust would light upon his clothes, to say nothing of the manner in which he kept sniffing the air as if he was on the point of calling for his smelling salts, I should freely and gladly have given him a synopsis of the processes involved in the manufacture of castings. As it is—well I should like to see the story after he writes it. When you consider that a man can work all his life in a foundry and then realize how little he knows, it is quite evident that it behooves a man to talk modestly. The molder's trade has so many offshoots and ramifications that it simply is out of the question for any man to attain proficiency in them all.

"Of the many jobs around a foundry demanding knowledge and skill probably the average molder would be inclined to say that the molding of an open sand plate is the simplest. It looks easy, nothing to do but level off a flat bed, bank a little sand around the pattern or templet, draw the pattern and pour in the iron; yet any foundryman of experience can tell you that with the exception of men who have had a considerable experience in that class of work, few molders can be trusted to do it properly. They seem to think that because the castings produced in this way usually are intended as part of the shop rigging or for some other purpose where smoothness of surface and accuracy of dimension are not essential, that any kind of a mold will do.

"While it is true in many cases that a rough face will not serve to condemn a casting of this character, still several fundamental points must be observed if the casting is to escape the scrap pile. Since it is just as easy to make a mold that will yield a true smooth casting as it is to make one that will produce a lop-sided and lumpy one, a molder who takes any pride in his trade should give the matter some consideration. In this connection it is pertinent to remark that many castings, large and small, usually made under copes can be made in open sand at a saving to the foundry in time and labor. Flat back castings in which only one face is exposed in service, castings laid in concrete and many other examples which readily will occur to the foundryman engaged in jobbing work, can be made in open sand and will be just as serviceable and present just as good an appearance as if poured under copes.

"The three most common mistakes of the inexperienced in the making of open sand castings lie in setting the



WITHOUT THE CONSOLATION OF THE NIGHTINGALE AND THE WHITE MOON BEAMS IT LOOKS LIKE A LONG, LONG TRAIL FOR BILL

straightedges, in preparing the sand and in gaging the density to which it must be rammed. Molten iron is a liquid and like all liquids will seek its own level. Naturally, therefore it follows that unless the sand bed is perfectly level the resulting casting will not be of a uniform thickness. It will be thicker at the lowest point of the sand bed and thinnest at the highest point. If the sand is not properly prepared, that is if some parts are too wet and other parts too dry, the metal will not lie against it quietly. It will bubble and boil over the wet spots, while the force of the flowing stream will *wash* the dry sand in front of it. When the casting is lifted out of the mold it will resemble something blasted out of a quarry more than anything else. The third item, tamping the sand, calls for the greatest discretion. If the face of the mold is made too hard, the sand will scab and cause the iron to boil; while if it is too soft the weight of the iron will press it down and the resulting casting will be too thick, if not actually swollen out of shape.

"Consider, first, the preparation of a sand bed for a plain, flat plate and afterward if we have the time and the inclination, we shall take up some of the minor changes and variations necessary in case the desired casting has projections on the lower side; or other features requiring special treatment.

"Assuming for illustration that we need a plate 6x4 feet, 1 inch thick, the necessary equipment will comprise four bricks or blocks, several wooden wedges, two straight edges about 7 feet long planed on one edge only and one parallel straightedge; that is one with both edges planed and parallel and about 6 feet long. A skillful molder can make a level bed by setting up four little piles of sand and adjusting the straightedges on these until the upper edges are level and parallel, but at best it is a makeshift and risky method and since bricks or small blocks are available in every shop, there is no need of taking any risks.

Laying Out the Job

"Having selected a suitable place, an outline is marked on the floor approximately 7x5 feet; or 6 inches more all around than the size of the desired plate. The four bricks are set, two on each of the long lines close to the corners. One of the 7-foot straightedges is placed on two of the bricks and carefully leveled by slipping one or two wedges between the brick and the straightedge at the low end. A few shovelfulls of sand are banked against the inside and a piece of pig iron laid up against the outside at each end to hold it in place. Then the second 7-foot straightedge is set up on the other pair of bricks.

"It is not necessary to try the level on this straightedge for the simple reason that it must not only be level but it also must be on the *same* level as the first straightedge. To secure this result the third or parallel straightedge is employed. One end is set on the first straightedge close to one end and the other end is placed in a corresponding position on the second straightedge. One or two wedges are inserted between the bricks and the second straightedge until the bubble in a spirit level resting on the parallel straightedge registers in the exact center. The same process is repeated at the other end. It stands to reason that if the second straightedge is leveled from two points on an already level line, it also will be level.

Supporting the Markers

"Sand then is banked against the inside and pieces of pig iron laid up against the outside as in the case of the first straightedge. The space between the straightedges is filled with sand, but not rammed and the parallel straightedge is employed to scrape the sand off flush.

"In the event that a pile of sand is not available, or for any other reason which makes it advisable to make the bed flush with the foundry floor, two narrow trenches are dug the necessary distance apart. The four bricks are disposed in the same manner and the straightedges adjusted as in the foregoing. In this case it is not necessary to employ pieces of pig iron to hold the straightedges in place. After they are leveled the trenches are filled with sand which is tramped lightly on the inside and butted with a rammer on the outside. The intervening sand between the straightedges then is dug up with a shovel to a depth of about a foot. It is not removed but simply dug up and turned over, the object being to loosen it up and see that it is in proper condition. From this point the preparation of the two beds is alike.

"If the proposed casting is to have a clean, smooth face, a thickness of facing sand will be needed on the bed; but if not, ordinary heap sand will be satisfactory. In either case a sufficient quantity to cover the bed to a depth of ½ inch should be passed through a ¼-inch riddle. The riddled sand is sprinkled over the bed in the manner familiar to all molders by giving the handle a quick twist as the sand is leaving the end of the shovel.

"To insure an even thickness of riddled sand all over the bed, the parallel straightedge again is employed in the following manner. A man at either end of the straightedge holds a gagger or a *soldier* about ½-inch thick between the lower edge of the parallel straightedge and the upper face of the straightedges forming the boundary of the bed. The straightedge is pulled from one end of the bed to the other, scraping the superfluous sand with it and leaving an even expanse of nice, soft, riddled sand standing ½ inch above the surface of the proposed bed.

"The sand is beaten down and a firm surface secured by commencing at one end, gradually advancing and bringing the parallel straightedge down in a number of smart, rapid blows until the entire surface has been covered. On a narrow bed, one that a man can straddle, he can perform the operation alone, but on a wide bed two men are required. One man holds his end of the straightedge firmly at a given point, only allowing enough freedom of movement for the man at the other end to rap down the sand for a distance of a foot or two; then the second man holds his end firmly while the first man raps down a similar area. After the entire bed has been treated in this manner, the straightedge is held down firmly and *see-sawed* back and forth, gradually advancing from one end of the bed to the other. The bed then is ready in the case of ordinary rough, open sand castings, but if it is desired to secure a casting with a nice smooth face, the bed is slicked with the trowel and blacked as in ordinary green sand molding practice."

"What a pity," I said, "that the young man left so hurriedly. If he had waited he would have heard a most interesting story."

"Maybe so," said Bill, "But I am going out now to look for the bird who threw that lead bag. I can't say that I'm sorry it landed where it did, but discipline is discipline and I bet you if I can lay my hands on that cuckoo he will hear an interesting story."

Elements Incorrectly Listed

In the article, "Cost of Synthetic Gray Iron Low," published in the issue of March 15 the names of the elements in the analysis of the iron were disarranged. The analysis should have read:

	Per cent
Total carbon	3.20–3.75
Manganese	0.25–0.40
Sulphur	0.040 max.
Phosphorus	0.055 max.
Silicon	1.75 to 2.25

H. A. Greaves and H. Etchells recently have been granted a new patent on a 3-electrode melting furnace. These patents are controlled by the Electric Furnace Construction Co., Philadelphia.

Studies the Total Tonnage Handled

Great Energy Is Consumed in the Manufacture of Castings Which Does Not Appear in the Total Weight of Casting Produced—Rehandling Adds to the Burden

BY MAX SKLOVSKY

IN INDUSTRIAL works the handling of materials generally is considered as being limited to the delivery or transferring of materials from department to department, or from one section of the plant to another. This work is frequently measured in terms of the number of common or unskilled laborers employed for the purpose. A phase of material handling, and one that is often overlooked, is that of handling materials in process or during operations. In most industries this is a much larger item than the delivery of materials and is overlooked too often. The operator engaged in performing a specific change in the material in many cases handles it several times, and such handling usually is classed as part of the operation rather than under the head of handling. A simple comparison will illustrate this point: In turning a small gear blank on a turret lathe an operator places a bar of steel in the lathe, which may require a period of time limited to one minute. The same operator manipulates various levers controlling the tools, and assists the machine in performing the several operations 40 or 50 times on a single bar of steel and covers a period of time from one to two hours. Such an operator is engaged in handling materials 5 per cent of the time and the balance of his time is devoted toward performing operations.

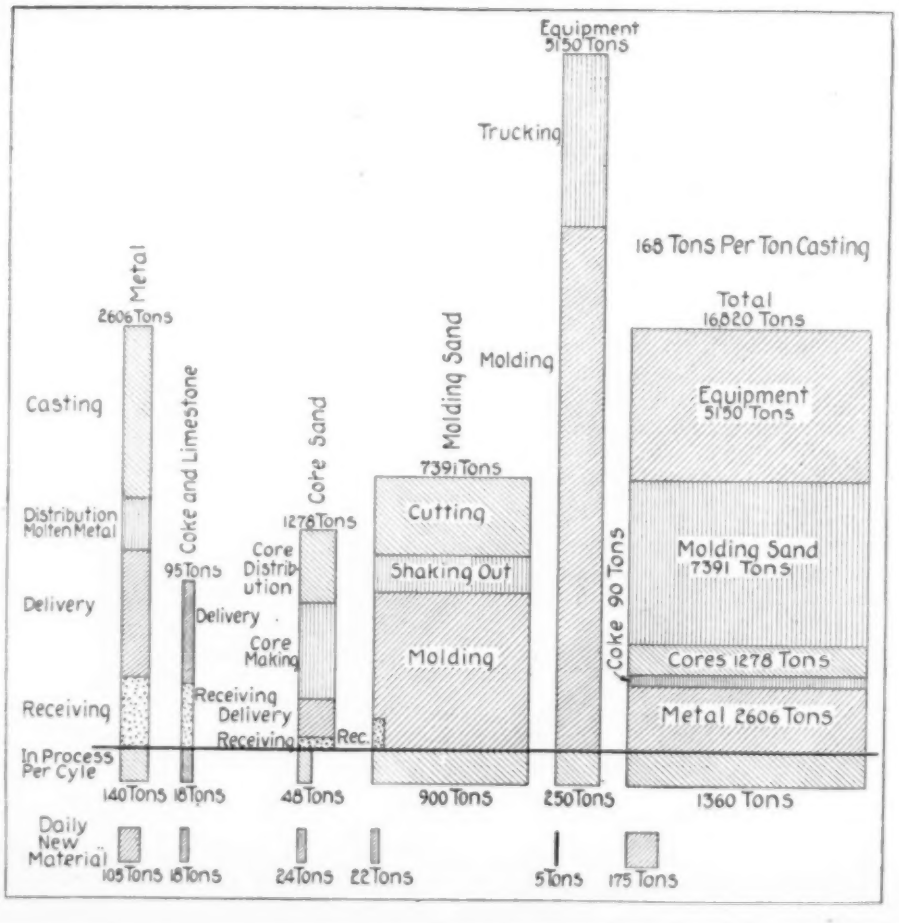
On the other hand, in making a mold in a foundry nearly all of the work consists in handling material, *i. e.*, handling equipment, handling patterns, handling the sand, handling the completed mold. Only incidently is there such other work as applying a swab, or operating the vibrating valve which represents operations in which material is not handled. In this case handling materials occupies nine-tenths of the time, whereas such other operations as jarring or squeezing represent less than one-tenth of the time. Obviously handling materials in the foundry industry is represented by a larger time element or labor-hour element than in the industries using machine tools for production. To what handling materials in the foundry occupies in importance may be noted from the examples in the accompanying table.

It is much simpler to demonstrate

The author, Max Sklovsky, is chief engineer, Deere & Co., Moline, Ill.

Graphic Representation of Materials Handled

THE immense amount of handling that is required to produce 100 tons of castings is detailed in the description, but it probably is better appreciated when shown diagramatically. The lower row shows the amount of new materials required, while the row below the heavy line indicates the amount of materials entering into the process per cycle. The diagrams above the line illustrate the results obtained by multiplication of the materials entering into the process by the number of times they are handled. Beginning at the left, the first row represents the metals handled; the second row, coke and limestone; the third row, cores and core sand; the fourth row, molding sand; the fifth row, equipment; and the last row is the total of all the others that are involved.



the quantity of materials handled in the foundries by assuming a specific case of a foundry producing 100 tons of good castings daily. On the average it will be necessary to receive materials into such foundry approximately as indicated in Section 1.

Shipping 100 tons of castings daily therefore requires the receiving of 175 tons of material daily. The delivery of the raw materials, however, is not an index of the total quantities handled daily from the point of receiving to the point of shipping. To demonstrate this each is listed separately.

Metal

In the instance considered, handling the purchased pig iron and scrap takes the course shown in section II.

Section III gives the procedure in delivering the metal.

After the metal is melted it is distributed according to Section IV.

The operations indicated in Section V succeed pouring the molds.

In all, it may be noted, 26 handlings of the metal are required involving a total weight of 2606 tons.

Coke and Limestone

The handling operations of coke used in melting metal in the cupola consists in the main of the operations shown in Section VI.

Limestone is handled substantially in the same manner as coke and adds a total of 5 tons.

Core Sand and Cores

Core sand is used in varied quantities in different foundries. In this instance the total cores required daily amount to 48 tons. Approximately 50 per cent of the core sand is reclaimable so that new sand is used to the extent of 25 tons daily. Reclaiming core sand involves somewhat greater handling than that of fresh sand. However, for the present purposes it is allowed that handling reclaimed sand is equivalent, ton for ton, to new sand or 48 tons daily of this material.

In the operations of making the

Method of Analyzing Weights of Materials Handled

SECTION I
PURCHASED MATERIALS

Pig iron and scrap	105 tons
Coke	18 tons
Limestone	1 ton
Core sand	24 tons
Molding sand	22 tons
Core binder materials	¼ ton
Facings	¾ ton
Miscellaneous supplies	4 tons
Total	175 tons

SECTION II
HANDLING PURCHASED PIG IRON AND SCRAP

1—Pig iron is unloaded from car onto metal chutes	45 tons
2—Pig iron is removed from end of chute and piled	45 tons
3—Scrap is removed from cars and thrown onto piles adjacent; and ⅓ wheeled to the farthest side of the pile and dumped	60 tons 70 tons
4—In addition 32 tons of foundry scrap and sprue are gathered, loaded, trucked and delivered to piles representing total of	128 tons
Total receipts	298 tons

SECTION III
DELIVERING METAL

5—New pig iron and scrap are both loaded onto trucks as charges are made up	105 tons
6—Metal is transported from the yard and up an elevator and delivered to the charging platform	105 tons
7—Foundry scrap is transported to charging platform	32 tons
8—Truck loads of metal, after being weighed, are brought to the cupola charging doors	140 tons
9—Metal is removed from the trucks and charged into the cupola	140 tons
Total delivered and charged	522 tons

SECTION IV
DISTRIBUTING METAL AFTER MIXING

10—Metal is poured off into bull ladles which are transported to the main aisle	133 tons
11—Metal is repoured from the bull ladles into smaller ladles, and conveyed to molders' floors	133 tons
12—The metal, less pig-bed iron, is then poured into molds.	130 tons
Total metal distributed	396 tons

SECTION V
OPERATIONS SUCCEEDING POURING THE MOLDS

13—Molds are dumped	130 tons
14—Castings are shaken out	130 tons
15—Castings are delivered to aisle	130 tons
16—Castings are loaded on trucks	130 tons
17—Truckloads in part are delivered to core knockout section	40 tons
18—Castings are rolled or thrown to remove cores	40 tons
19—Castings are reloaded onto trucks	40 tons
20—Castings are delivered to cleaning department	110 tons
21—Castings are loaded into mills or sand blast	110 tons
22—Castings are removed from mills	110 tons
23—Castings are delivered to chipping section and to grinding section	110 tons
24—Castings are handled in the operation of chipping, grinding and inspection	100 tons
25—Castings are reloaded for weighing	105 tons
26—Castings are transported to storage	105 tons
Total castings separated and cleaned	1390 tons

SECTION VI
HANDLING COKE AND LIMESTONE

1—Coke is unloaded from box car into wheelbarrows	18 tons
2—Wheelbarrow loads are trucked onto the piles and dumped for delivering	18 tons
3—Trucks are loaded from the bins in the yard	18 tons
4—Trucks are hauled over the yard and delivered into the yard and up an elevator to the charging platform	18 tons
5—Trucks set in front of the charging door and the coke is charged into cupola	18 tons
6—Total for limestone	5 tons
Total	95 tons

SECTION VII
HANDLING CORE SAND

1—Unload from car into bins along track including reclaimed sand	48 tons
2—Cut over sand to the farthest position	12 tons
3—Reload truckloads of sand for delivery	48 tons
4—Cart trucks to sand-mixing department	48 tons
5—Shovel sand into mixers	48 tons
6—Dump sand from mixers and refill trucks	48 tons
7—Deliver mixed sand to core molders	48 tons
Total-6-¼ handlings	300 tons

SECTION VIII
CORE SAND HANDLED WHILE MAKING CORES

8—Shoveling sand into core boxes	48 tons
9—Turning loaded core boxes over on plates	48 tons
10—Lifting onto truck racks	48 tons
11—Removing truck racks to ovens	48 tons
12—Setting core plates into ovens	48 tons
13—Removing core plates from ovens	48 tons
14—Delivering core plates to finishing benches	48 tons
15—Removing cores from core plates	48 tons
16—Turning over cores for blacking	48 tons
17—Removing cores from benches into pans	48 tons
18—Setting pans on trucks	48 tons
19—Removing pans from trucks onto storage shelves	48 tons
Total making and drying cores—12 handlings	576 tons

SECTION IX
DISTRIBUTING CORE SAND

20—Removing cores from racks into delivery pans	48 tons
21—Setting delivery pans on trucks	48 tons
22—Cart trucks to foundry floors	48 tons
23—Remove core pans from trucks and deliver to molders, ½	19 tons
24—Unload cores onto molder's shelves, ½	19 tons
25—Molder sets cores into molds	48 tons
26—Molder carries in mold to floor	48 tons
27—Mold is dumped with cores	48 tons
28—Cores are picked off from molders floors of from knockout floors, and—80 per cent—cores are loaded onto trucks	38 tons
29—Used cores are transported to reclaiming department	38 tons
Total cores handled in foundry—10 handlings	402 tons

SECTION X
RECEIVING AND DISTRIBUTING MOLDING SAND

1—Unloading from car into bins	22 tons
2—Cutting ½ of the sand in the bins to farthest position	11 tons
3—Reloading sand for delivery into trucks	22 tons
4—Deliver truckloads of sand to foundry	22 tons
5—Dumping sand into foundry	22 tons
6—Spreading sand over floor heaps	22 tons
Total sand distribution—5½ handlings	121 tons

SECTION XI
SAND HANDLED DURING MOLDING

7—Molder handles sand in 6 operations; 40 times the weight of castings	4400 tons
8—Dumping—one operation—nine times the weight of the castings	990 tons
9—Cutting sand in two handlings	1980 tons
Total sand in operation including new sand	7391 tons

SECTION XII
EQUIPMENT

Equipment handled in Molding Operation	3850 tons
Miscellaneous Equipment	1300 tons
Total	5150 tons
Miscellaneous handling	200 tons

cores the sand is again handled as outlined in Section VIII.

The distribution of cores from storage into the molds is shown in Section IX.

The total handling of core sand and cores is represented by 29 distinct handlings in which the total weight involved is 1278 tons.

Molding Sand

In handling molding sand some variation in the relative quantities exists. In this instance the total new sand used is 22 tons daily. The new sand is received and distributed according to Section X.

Rehandling the molding sand to the molders' floor may be estimated from the following example. Molding with a small hand squeezer using a snap flask on a mold having an average weight of sand of 54 pounds; the weight of the snap sand is 6 pounds, the weight of the bottom board 4 pounds, the weight of the match and gate 15 pounds. The operations of the above are as follows:

Put on match	15 lbs.
Put on drag flask	6 lbs.
Screen sand over patterns	8 lbs.
Shovel sand on patterns	22 lbs.
Strike off	.....
Put on bottom board	4 lbs.
Squeeze	.....
Lift and roll over	51 lbs.
Remove match	12 lbs.
Put on cope flask	6 lbs.
Screen sand	8 lbs.
Shovel sand on pattern	22 lbs.
Put on cope board	4 lbs.
Squeeze	.....
Lift coke board	4 lbs.
Lift coke and flask	33 lbs.
Draw pattern	3 lbs.
Close mold	33 lbs.
Remove flask	12 lbs.
Carry mold to floor	58 lbs.
Total	301 lbs.
Average weight per operation	18 lbs.

In the foregoing no cores are used and the weight of the castings is approximately the weight of the pattern; that is, 3 pounds. It will be seen that the ratio of materials handled to the weight of the castings is 100 times as great. Of the 301 pounds indicated the sand handled is equal to 230 pounds so the total sand handled by the molder, in this instance, is approximately 80 times the weight of the castings produced. The weight of the sand in the mold is 18 times as great as that of the castings. This ratio ordinarily ranges from 8 or 12 to 1 and a conservative average, therefore, is ½ the ratio of the case cited, or roughly 40 times as much weight of sand is handled by the molder as the weight of castings produced. The sand on the molders' floor is 9 times the weight of castings produced. The sand on the molders floor is also rehandled in cutting and preparing it. This is usually 1½ to 2½ times according to the practice established. In the dumping and shaking out operation there is an additional handling of the sand. The foregoing is tabulated in Section XI.

In handling the various materials as described it is necessary to handle simultaneously the equipment of trucks, flasks, patterns, ladles and tools. In the example given of a snap flask job a total of 71 pounds of flask, match, bottom board and pattern equipment is handled. There is in addition the shovel, riddle and other tools which bring the total equipment handled in making a mold to about 105 pounds. In the example mentioned this is equal to 35 pounds per pound of castings or about 25 pounds for the average. On floors where iron flasks are used this weight is increased to about 40 pounds per pound of castings. On the average for the entire foundry the molding equipment handled is approximately 35 times the weight of the castings. In addition to this the trucking equipment for all the materials handled approximate 1000 tons. Miscellaneous equipment includes ladles, core plates, core pans, core-delivery trucks and other items and makes a total for trucking of 1300 tons.

Daily accumulations of refuse amounts to handling to about 25 tons daily. Collecting, trucking and delivery this to the point of destination amounts to handling about 125 tons.

Aside from a large quantity of water used for wetting the sand and which is rehandled in cutting, there are also such other materials as core binder oils and miscellaneous materials which readily add up to 75 tons, making a total of 200 tons miscellaneous handling.

Summary

Summarizing the figures in the table; materials grouped as follows are handled daily in the foundry specified:

Metals	2606 tons
Coke and limestone	95 tons
Core material	1278 tons
Molding sand	7491 tons
Equipment	5150 tons
Miscellaneous	200 tons
Total	16,820 tons

This is an astounding quantity for the production of 100 tons of castings. Probably no industry of heavy production quite compares with the foundry business in the tonnage of materials handled for the tonnage produced.

In handling raw materials by manual labor the ordinary laborer will handle from 10,000 to 100,000 pounds of material per day depending upon the character and distance that the material is handled. In well equipped foundries, this averages about 40 tons per day per man for all the men employed, including the molders and other skilled men. It is obvious that the skilled men spend most of the time doing common labor, or handling materials. The necessity as well as the possibility of handling materials in foundries with the proper facilities is apparent. The foundry, when viewed from the side of material handling, offers a fruitful field for real progress.

Cores Stick to Dryers

Question: We are making some large cores in cast iron driers and are experiencing considerable difficulty in having the core leave the drier. We have wiped the drier over with coal oil, but this does not seem to work satisfactorily. Could you advise us of any solution that we might wipe over the drier to make the core leave it freely? Any information you can give us along this line will be greatly appreciated.

Answer: We should be in a better position to diagnose your trouble if you had been a little more explicit or if you had furnished further particulars. Cores stick to the driers from any one of four principal causes. Of course they will also stick from a combination of those same causes. (1) The sand is mixed too wet. (2) Too much binder or clay in the core sand mixture. (3) No vent holes along the bottom and sides of the drier. (4) Cores are not thoroughly baked.

Anointing the drier with oil or any other composition will not clear the cores if any one or combination of the foregoing conditions are present. Where the shape of the drier makes the practice feasible a single thickness of newspaper placed between the core and the shell of the drier will strip the core even when other conditions are not favorable.

Separates Foundry from Machine Department

The Woburn Machine Co., Woburn, Mass., has separated the foundry department from the machine company proper under the name of the Woburn Brass & Iron Foundry. The new company has been incorporated with the following officers: Daniel P. O'Brien, president; Thomas H. Marrinan, treasurer and George H. Foley, secretary.

Robert C. Weller has been appointed sales manager of the Lakewood Engineering Co., Cleveland. Carlton R. Dodge has been appointed western sales manager of the same company with headquarters at 1215 Lumber Exchange Bldg., Chicago.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 8 x 7 inches, and may be readily bound in note book form.

SLING CHAINS AND HOOKS FOR CRANE USE

By George W. Childs

Sling chains, hooks and all appurtenances purchased from manufacturers are designed for certain safe loads which are specified. Every part, link and hook is proportioned to withstand certain stresses, and a factor of safety is provided which gives a margin between the working load and the ultimate load which the part will stand. In forging repair links, or making hooks for various uses, the correct design is of great importance. The following tables which give the dimensions which are indicated on the drawings, Data Sheet No. 378, will be found of service in making replacements.

Size of Chain-G	Dimensions in Inches A	B	C	D	E	F	Length in feet L	Hook No
5/8	9 5/8	4 1/2	1 3/8	4	1 3/8	5/8	12	26
3/4	12	5	1 1/2	5	2	7/8	12	29
7/8	12 3/8	5 1/2	1 3/4	5	2 1/8	1	12	32
1	13	5 1/2	2	5 3/4	2 1/2	1 1/8	12	32
1 1/8	14	6 3/4	2 1/2	6 1/2	3	1 1/2	12	36
1 1/4	15	7	3	6 1/2	3 1/4	1 3/4	12	36

Standard Sizes for Hooks on Working Members

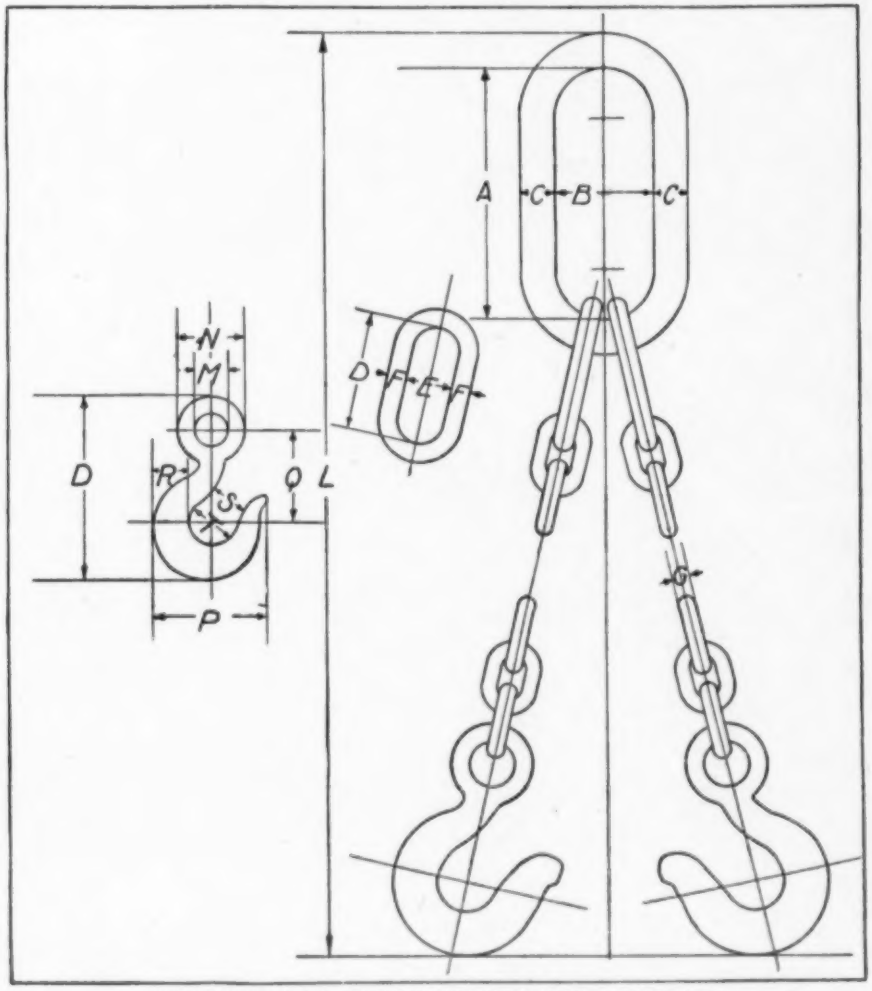
Number of Hook	For U. S. Standard Cable Chain "Size."	M	N	O	P	Q	R	S	T	Capacity Net Tons Safe Work	Load to Str'n out
26	5/8	1 1/8	2 1/2	6 13-16	4 3/8	3 1/2	...	1 1/8	1 3/8	1.7	7
29	3/4	1 3/8	3 1/8	9 9-16	6 1/4	4 1/8	...	1 1/2	2 1/2	3	13
32	7/8 and 1	2 1/4	4 1/2	12 13-16	8 1/8	6 3/4	2 1/4	2 1/2	3 1/4	5.5	26
36	1 1/4 and 1 1/8	4	8 1/2	22 9-16	15	11	5	4 1/2	5 1/2	20	80

(Concluded on Data Sheet No. 378)

SLING CHAINS AND HOOKS FOR CRANE USE

By George W. Childs

(Concluded from Data Sheet No. 377)



DETAILS OF SLING CHAINS AND HOOKS FOR CRANE USE

Makes Comparisons of Melting Costs

Ohio Steel Castings Company Operating Both an Electric and an Open-Hearth Furnace Gives Data Covering the Two Processes from Which Estimated Costs Are Calculated

COMPARATIVE cost figures for operations in different plants are extremely complicated by many varying factors which enter into the production of castings. Of course, certain steps can be compared closely as to cost; but when the totals are summed up, so many elements are included that an opportunity is given for the management of the high-cost shop to find extenuating circumstances and throw a different light on the figures. An illustration of this is to be found in the case of one large company which has several foundries in different parts of the country none of which makes exactly the same line of castings. A monthly cost sheet is made in each foundry, using the same accounting system, yet the superintendent of the foundry showing the highest cost per pound can show that he really is producing his chief line of castings cheaper than any other of the foundries. Then after one hears each superintendent analyze the cost sheet to prove the efficiency of his own foundry operations the listener wonders at the marvelous flexibility of foundry cost finding methods and analysis. This fact of variables under divergent conditions has made it difficult to compare directly the cost of melting by the several methods in common use. Add to this the variation in the cost of the materials which can be used in the different melting processes and the problem is even more complicated. With these variables to interfere, it is almost impossible to secure dependable comparative figures on the costs of two melting processes. Cost figures as recorded by the Ohio Steel Foundry Co., Lima, O., in comparison of metal costs for the electric and open-hearth furnaces operated by it serve as a basis from which the possibilities of both processes can be estimated as the conditions of operation are similar.

Detailed costs of both the electric furnace and the open-hearth for the month of October, 1920, are shown in Table I. The two furnaces are in foundries located in neighboring towns in central Ohio, the electric furnace being at Springfield and the open-hearth furnace at Lima. However, stock purchased at one time is used by the one furnace while the other furnace is consuming metal purchased at another time. For this reason direct comparison can not be made in stock metal costs. However, charges can be computed based on costs of materials at any set time. Analyzing the figures given in Table I, it is found that the alloys and other materials used for treating the charge in the electric furnace cost $1.62 per ton as follows:

EIGHT TONS OF METAL ARE CHARGED INTO THE ELECTRIC FURNACE WHICH IS RATED AT 3 TONS

Ferrosilicon	$0.35
Ore	0.02
Aluminum	0.03
Spiegel	1.22
Total	$1.62

Alloys for oxidizing and deoxidizing the open-hearth steel cost $2.07 per ton when the cost of ferrosilicon is figured at the same price as that at which it was charged to the electric furnace, are tabulated as follows:

Ferromanganese	$1.60
Ferrosilicon	0.45
Ore	0.02
Total	$2.07

Less deoxidizing alloy in the form of ferrosilicon is required in the ladle by electric steel. The reason for this is that in the electric process the metal absorbs silicon from the bottom material by reason of carbon deoxidizing the silica sand and liberating silicon which is absorbed by the metal and remains as residual silicon. This residual silicon acts the same as silicon added in the ladle and thus reduces the amount necessary for this purpose and reduces the cost for ferrosilicon which was $0.10 per ton higher for open-hearth steel than for steel made in the electric furnace.

The use of spiegel in the electric furnace also reduced the cost of alloys. This reduction amounted to $0.38 per ton, and the total apparent reduction of costs for alloys in the electric furnace process was $0.45 per ton. However, owing to the low percentage of manganese in spiegel compared to that in ferromanganese, a larger percentage of spiegel was used. The proportion of alloys added in the electric furnace thus was increased. The total of 2.7 of alloys was added to the electric furnace against a total of 1.9 per cent to the open-hearth. This extra 0.8 per cent was mostly in the form of iron in the spiegel and if this is credited to the alloy cost of the electric furnace steel at the cost found for the steel it will reduce the cost of alloys for this process $0.33, leaving a spread between the alloy cost of the two melting methods of $0.78 per gross ton of metal in the ladle.

Now it is more difficult to calculate the difference in cost of the metal charge because of the various selections of scrap which is possible. As is shown in Table I the cost of even the same class of scrap purchased at different times will vary as in the case of clippings which are charged at $28.23 and again at $23.00 per ton. However, by noteing the percentages of the various kinds of scrap used in both processes it is possible to calculate a theoretical charge based on prices at any time or place. The electric furnace charges consisted of: Clippings, or boiler plate punchings, 19.5 per cent; heavy drop forgings 13.9 per cent; turnings 17.3 per cent; shop scrap 46.6 per cent; total 97.3 per cent. The open-hearth process used:

Table I

Metal Costs for Electric and Open-Hearth Furnaces for Oct. 1920

Description of Material Charged	Spfld. Consumption in pounds	Lima Consumption in pounds	Spfld. Price Per Ton	Lima Price Per Gross Ton	Total Cost Elec. Furnace	Total Cost Open Hearth
Shells		1,015,300		22.00		9,971.09
Shells		1,056,600		22.00		10,376.89
Clippings	234,301	145,000	28.23	23.00	2,952.66	1,483.45
Salvage		46,400				
Bess. Iron		434,500		44.90		8,708.98
Manganese		38,850		165.00		2,806.32
Silicon 49.12%	5,495	21,850	85.00	83.70	208.48	816.33
Ore	2,760	10,000	9.11	7.25	11.22	32.36
Shop Scrap	561,796	933,700	25.06	18.00	6,284.81	7,502.45
Turnings	207,897		18.00		1,673.57	
Hvy. Drp. Forgings	167,247		28.95		2,161.50	
Aluminum	60		.338		20.28	
Spiegel 30-40%	24,324		67.50		732.88	
	1,203,880	3,702,200			14,045.40	41,697.87

602 Tons of metal charged in Electric Furnace. 95% of melt in ladle equals 572 tons net. 1851 Tons of metal charged in open-hearth furnace. 95% of melt in ladle equals 1,758 tons net.

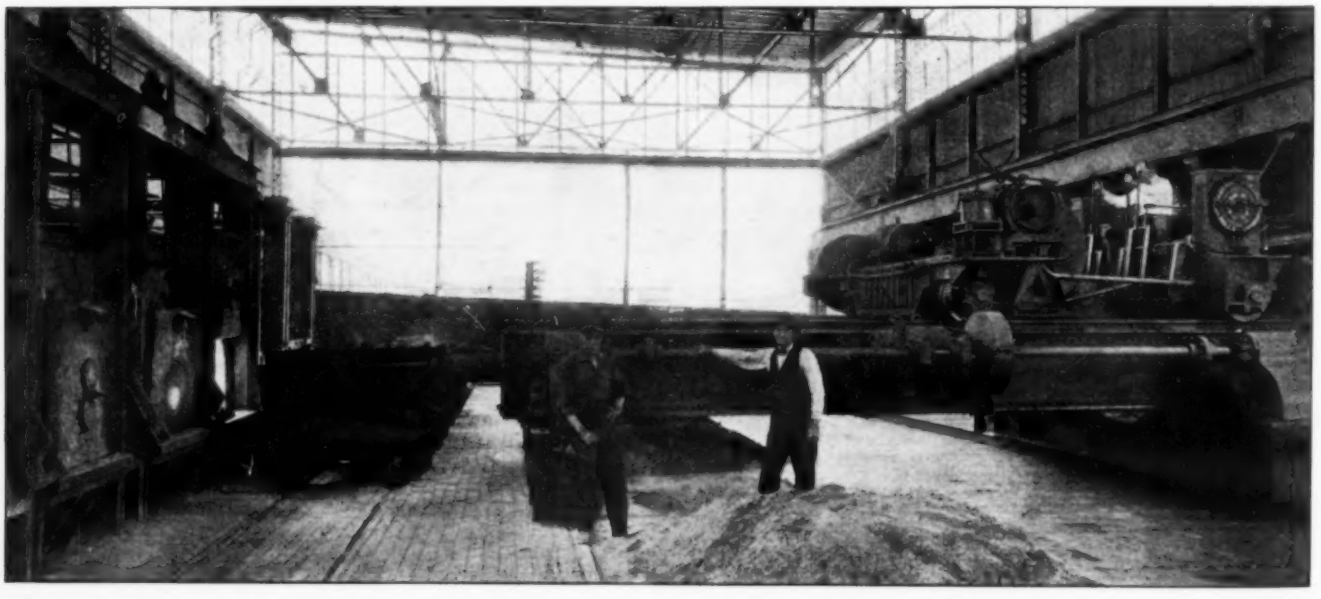
Cost Per Ton of Metal in Ladle

	Springfield		Lima	
	Cost in Money Metal	Cost per Ton of Metal	Cost in Money	Cost per Ton of Metal
Metals	14,045.40	24.55	41,697.87	23.72
Electrodes	440.37	.77		
Electric Furnace Current	6,877.14	12.03		
Fuel Oil	194.80	.34	13,946.97	7.93
Labor	1,373.26	2.40	3,175.60	1.80
Repairs	430.71	.75	264.30	.15
	23,361.68	40.84	59,084.74	33.60

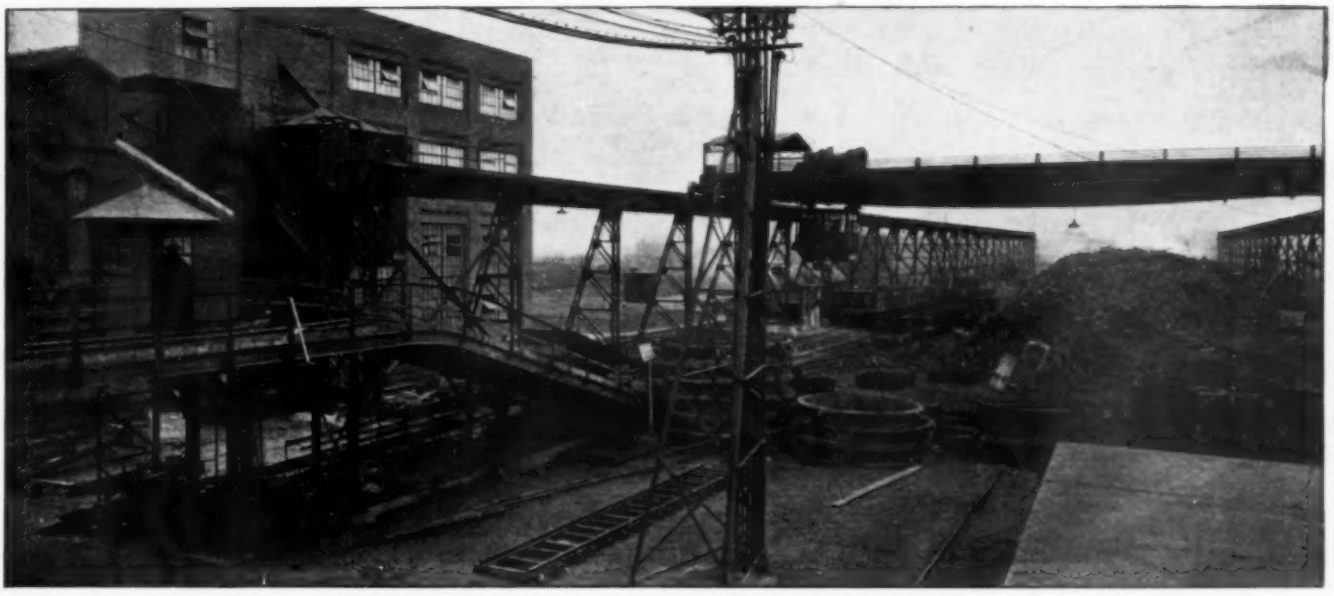
shells 56.0 per cent; clippings 3.9 per cent; salvage 1.3 per cent; bessemer pig iron 11.7 per cent; total 98.1 per cent. Surveying these figures, a few marked characteristics may be noted in the two charges. A larger percentage of shop scrap is used in the electric furnace process than in the open-hearth, mainly due to making a larger percentage of sprues and risers in this foundry. The classes of castings made in the two foundries account for the differences in the percentage of sprues and risers made. In the Springfield foundry, where electric melting is carried on, small castings requiring especially hot metal are produced, while larger castings are made from the open-hearth metal. Aside from the shop scrap and salvage, which is practically shop scrap, three classes of scrap have been used; namely low-phosphorus, medium heavy scrap in the form of heavy drop forgings and shells; low-phosphorus, light melting scrap in the form of clippings, or boilerplate punchings; and turnings. From these figures a charge based on quotations at a definite time can be calculated. For the purpose figures given in *The Iron Trade Review*, Dec. 30, are taken. Shop scrap and salvage are calculated at the price of low-phosphorus scrap which is given as $24 a ton. The price of clippings, or boiler plate is shown to average approximately $12, and turning about $9 per ton. Bessemer pig iron is quoted at $35, valley. The cost of metals for a charge in each of the furnaces based on the figures given in this paragraph, and on the actual cost of the alloys as shown in Table I are indicated in Table II.

Exceptions might be taken to this method of figuring metal costs. For instance, it might be contended that the price charged for shop scrap is too high. However, if it is too high the effect is equally balanced, for in producing the same kinds of castings in both furnaces, the shop scrap from the two processes would be equal. Some foundrymen also might use more turnings in the electric furnace and thus lower the cost of its charge, but the management of the Ohio Steel Foundry Co. feels that there is too much uncertainty in purchasing turnings in which some high-sulphur or high-phosphorus stock might be mixed. Therefore, this company does not use turnings on any heats on which castings are made to specification as to the sulphur and phosphorus content of the metal.

So, while some leeway is possible in the selection of higher or lower priced scrap, the operating figures for the month of Oct. 1920, of the Ohio Steel Foundry Co., show that metals per net ton cost $24.55 for the electric furnace and $23.72 for the open hearth. Figures in Table II, based on what might be done using similar scrap at prices of Dec. 30, 1920, indicate a comparative cost of $19.77 for the electric furnace metal



THE NEW CHARGING MACHINE ACCOMPLISHES THE WORK FORMERLY REQUIRING 18 MEN—J. E. GALVIN, PRESIDENT OF THE COMPANY, IS AT THE OPERATING LEVERS



METAL IS LOADED INTO BOXES IN THE STOCK YARD BY A CRANE—IT IS CARRIED UP THE INCLINED PLATFORM ON BUGGIES AND RUNS BY GRAVITY TO THE CHARGING FLOOR

charge and $24.85 for the open-hearth charge.

The other expense items besides the metal are shown in the lower portion of Table I. These include electrodes, current, fuel oil, labor and repairs for the electric furnace, and fuel oil, labor and repairs for the open-hearth. Fuel oil charged to the electric furnace was used for heating ladles. Lining and slag materials are lumped in the item, repairs, which also includes the labor involved in repairing the furnaces. A record for these cost elements for six months as shown in Table III gives a good average of the different items for comparison. Electrodes, costing $9.16 for electric furnace steel do not appear on the debit against the open hearth. Heat is supplied by current and fuel oil. The total of these two items charged against the electric furnace amounts to $10.65 per ton, while fuel oil cost the open hearth only $6.10 per ton. Further, labor and repair costs are higher for the electric furnace than for the open hearth, being $3.35 and $1.27 respectively for the electric furnace and $1.88 and $0.45 for the open hearth. The labor costs of the open hearth do not include the salaries of the melters which are figured in the labor costs of the electric furnace. This item would add $2.35 a ton to the labor cost on the open hearth making it $4.23 per net ton.

By using the costs for the metal in the charges calculated from prices of Dec. 30, the following list indicates the relative costs of metal made by the two processes:

	Electric	Open hearth
Electrodes	$ 1.53	
Current	10.36	
Fuel oil	0.25	$ 6.10
Labor	3.35	4.23
Repairs	1.27	0.45
Metal	19.77	24.85
Total cost per net ton	$36.57	$35.63

These figures which indicate the cost of the open-hearth steel to be only 0.94 per ton less than the cost for electric furnace steel are, of course, only roughly relative and would not be duplicated under different circumstances or in other cities, where charges for electric current and labor conditions might be different. Too, the method employed in operating the furnace has a strong bearing on the cost.

The electric furnace at the Springfield plant is the Pittsburgh, or Moore type and has a rated capacity of 3 tons. However, the bottom is so arranged that by tilting the furnace back and partly closing the pouring spout, 8 tons can be melted by the furnace at a single charge. This allows 4 tons to be poured and leaves a melted bath of from 3 to 4 tons of metal into which 4 tons of cold stock is charged for the next heat. The advantage claimed for this method of operation is that a steadier arc is maintained than if cold metal were charged into an empty furnace. Its efficiency is indicated by the fact that as high as ten, 4-ton heats have been taken out of the furnace in 12 hours and 5 minutes. Another gage of the cost of operating this furnace may be found in the rate of output. In October, 191 heats were poured in 26 days, or an average of a little more than 7 heats a day from half-time operations. Had the furnace been operated 24 hours a day as was the open hearth, the cost of power and electrodes consumed per ton of metal made would have been reduced.

While the electric furnace was not operated to capacity in the month cited, even for 12-hour operation, neither was the open hearth. In the 26 days of that month 92 heats

Table II

Cost in Dollars Per Net Ton of Electric and Open-Hearth Steel

	Electric			Open-Hearth		
	Per Cent in Charge	Per Gross ton	Per Charge	Per Cent in Charge	Per Gross ton	Per Charge
Low-Phos. scrap (shells, forgings, shop scrap and salvage)	60.5	24.00	14.52	82.5	24.00	19.80
Clippings	19.5	12.00	2.34	3.9	12.00	.47
Turnings	17.3	9.00	1.56			
Bessemer Pig Iron				11.7	35.00	4.10
Ferromanganese						1.60
Ferrosilicon			.35			.45
Ore			.02			.02
Aluminum			.03			
Spiegel			1.22			
Total			20.04			26.44
Cost per net ton calculating a 5-per cent melting loss			19.77			24.85

Table III

Cost in Dollars Per Net Ton Over a Period of Six Months

	Electric Furnace Metal					Open-Hearth Metal		
	Electrodes	Current	Fuel Oil	Labor	Repairs	Fuel Oil	Labor	Repairs
May	1.75	9.20	.21	3.37	2.93	8.05	2.14	.43
June	1.88	9.90	.16	3.53	.65	3.74	2.19	.26
July	2.03	10.66	.17	3.80	.70	3.83	2.23	.27
Aug.	1.91	10.06	.54	4.04	1.96	7.17	1.40	.20
Sept.	.82	10.30	.32	2.93	.61	5.90	1.54	1.40
Oct.	.77	12.03	.34	2.40	.75	7.93	1.80	.15
Total	9.16	62.15	1.74	20.07	7.60	36.62	11.30	2.71
Average per net ton	1.53	10.36	.29	3.35	1.27	6.10	1.88	.45

were poured from the open hearth whereas it is possible to melt more than 150 heats in that time, a record for this furnace being 35 heats in a week.

Much expense also can be saved or lost by the method of charging adopted. The stock for the 3-ton electric furnace is loaded into boxes and weighed on a platform scale in the stock yard. It is brought to the furnace on industrial cars pulled by an electric truck, then charged by hand. The 4 tons are charged in approximately 15 minutes by four men, the two furnacemen who work on the furnace continuously and two laborers. Contrasted to this method is the thorough system used in the open hearth department to eliminate manual labor. The stock yard is covered by a traveling crane which loads the charging boxes with scrap and pig iron using a lifting magnet. When the cars are loaded the crane, holding to them with the magnet, draws them to the foot of an incline, Fig. 3, where they are grasped by dogs on an endless chain and carried to the top of the incline which is slightly above the level of the charging platform. From here the cars, owing to a gradual slope in the track, run to the furnace and the boxes are unloaded into the furnace by a charging machine which may be seen in Fig. 2. In this way all metal is charged into the furnace by the operators of the yard crane and the charging machine and with the full time of one man in the stock yard. This man fills enough extra boxes in the day time to keep the furnace operating at night. Formerly, before the charging machine was installed, three turns of six men each were employed to charge the furnace.

Interest on investment and depreciation charges were not estimated in the cost figures given in this article, because the variation in these is too great according to the rate of operation to give a definite basis for calculation. The 3-ton electric furnace with its electrical equipment does not cost as much as the 20-ton open-hearth furnace with its charging equipment and larger building. Thus the interest charges would be lower for the electric furnace but the interest charge per ton would vary inversely in proportion to the amount of metal produced in the furnace in any given time. Depreciation charges also would be dependent upon the rate of production and whether the electric furnace was operated on a full 24-hour basis or only with a single turn of 8 or 12 hours.

How and Why in Brass Founding

By Charles Vickers

Counteracting Aluminum in Brass Mixtures

We note that when scrap metals are used that aluminum frequently is found in the castings made therefrom. This presence of aluminum is a serious matter when the castings must withstand hydraulic or air tests. As this evil appears to be growing and probably affects more or less the general brass foundry business, any information you might have on file concerning this subject would be of great interest. Is there any alloy which can be used to offset this bad effect of aluminum?

Replying to the last sentence first, there is no alloy that has so far been discovered that will counteract the evil effects of aluminum.

Should there be only a small percentage of aluminum present it can be removed by the addition of copper oxide which addition should be made preferably with the cold metal. In the case of grindings, turnings and such finely divided material the admixture of copper oxide with the material before it is melted is an effective way to clean out the aluminum. In all cases the alloys should be melted hot. When the aluminum is present in quantity it takes patience and a large amount of oxide to remove it. Approximately eight times the amount of the aluminum will be required. This has been determined by experiment. Some melters claim to remove aluminum by the use of borax and while this might be possible such a statement would require to be proved before it would be generally believed, as the temperature of this reaction is beyond that of the molten bronze. Borax does no harm, however, and it might be tried. It would be necessary to use anhydrous borax and to get the metal hot.

Hardening Mixtures for Trolley Wheels

We are making trolley wheels of scrap brass but they appear to be too soft. Can you suggest anything that we could add to make them harder?

We suggest the addition of tin to make the alloy harder. The amount of tin to add should be 2 per cent for the first heats, but if the wheels are then found to be still too soft, increase the tin addition to 3 per cent.

A scrap brass trolley wheel, however, will not give good service, as the brass undoubtedly will be leaded, and also will vary in composition from heat to heat. An excellent mixture for trolley wheels is the following: Copper, 84 per cent; tin,4 per cent; phosphor-tin, 2 per cent. If phosphor-copper is preferred to phosphor-tin, use the following alloy: Copper, 93.25 per cent; tin, 6 per cent; phosphor-copper, 0.75 per cent.

Prevents Lead Separating Out of Alloy

We are manufacturing car journal brasses which have a lead content of 20 per cent, and are having trouble in holding the lead in solution. Can you suggest a method of introducing the various metals so as to accomplish the result desired?

The lead will fall out of the castings upon solidification if tin is absent from the mixture. A standard mixture for car journal bearings follows:

STANDARD MIXTURE FOR CAR-JOURNAL BEARINGS

Copper	70 per cent
Lead	20 per cent
Tin	5 per cent
Zinc	5 per cent

The above mixture will not segregate and a large number of journal bearings are made of this mixture or one closely approximating it. If, however, it is undesirable to change the present mixture to conform to the above, a flux composed of plaster of Paris and about 10 per cent borax will hold in the lead. Use 1.5 per cent or more of the flux if required.

Deep Core Required to Give Pressure Head

In making bronze sleeves 7 inches long, 2⅝ inches outside diameter, with 1½ inch core, we found the sand raised and spoiled the castings. The flask we used was 6 inches thick, which gave us 1 11/16 inches sand around the mold. Do you think the flask is not high enough, and that we should have a greater thickness of sand at the thinnest part?

The cores were made with linseed oil and baked until they were dark brown and quite hard; do you think that gas thrown off from the core could have caused the trouble? We used a riser about 2 inches high to give weight of metal to raise it in the mold. Do you think we have rammed the sand too tight? The cope was made as follows: White sea sand, 3 parts, wheat flour, 1 part; molasses water to wet. The molasses water was made with 1 part molasses to 4 parts water. Instead of the molasses water, the formula stated that boiled linseed oil could be used, and cut the flour in half. We used the linseed oil instead of molasses, but did not use any water; should we have done so?

Is it necessary to put vent holes over the casting to allow the gases to escape? There did not appear to be any blow holes in the castings, only they did not come out in the proper shape, being flat on top where the metal ran when the sand raised. Any suggestions you may be able to offer in regard to our difficulty will be appreciated.

A flask 6 inches deep we assume would give a 3-inch cope and drag this would allow sufficient sand over the patterns in the drag but not sufficient in the cope for a casting like these bushings. The height of the cope should be increased when molding the same by placing on top of the cope half, a wooden frame 2 inches deep and of the proper dimensions to rest on the upper edge of the flask. When the whole is filled with sand and rammed the frame or "deepener" would be held in place by the firmly rammed sand, and the result is a deepened cope. This would give 3-11/16 inches of sand over the patterns, and the top of the sprue or the top of the riser would be that height above the top of the patterns. This will give enough hydrostatic pressure to ensure the metal running up into the cope and remaining there as it solidifies resulting in a casting true to pattern. If the castings had been solid instead of cored out, a still higher cope would have been required in order to hold up the metal and avoid shrinkage on top, and in this case another 2-inch frame would have been needed on top of the cope to make sure of getting perfect castings. While a thick cope will withstand more pressure than a thin cope from the metal poured into the mold, the thickness of the cope has nothing to do with this difficulty, for the sand in the cope can be prevented from raising by placing weights on the top of the cope. This always should be done in any event. Simply place a smooth board on the top of the cope and pile thereon anything that will have weight enough to hold down the cope. This board should not rest on the sand. It should rest on the top of the frame or the top of the flask, but should have a bearing on the sand; if the weight rests on the sand it will crush in the mold. Therefore, greater thickness of sand is required in this case. The core sand also is at fault. The cores were too hard, they should contain water as follows: Dry white sea sand, 7 pounds; dry molding sand, 5 pounds; mix with water to the consistency of molding sand. Then add 6 ounces of linseed oil, and thoroughly mix with the damp mixed sands.

It is not always necessary to vent the top of a mold; this will depend upon the porosity of the molding sand, and the hardness with which it is rammed into the flask. In the present case it would be well to vent the cope with a fine knitting needle to provide means for the gases generated by the hot metal to escape.

Aluminum Alloys Shrink

We wish to make some aluminum patterns from wood patterns, and we understand there is an aluminum alloy that does not shrink, and that by making molds from our wood patterns and casting them with this aluminum alloy we will get an aluminum pattern of identically the same dimensions as the wood pattern. Can you furnish us with full information regarding this alloy?

A shrinkless aluminum alloy has not so far been developed. All alloys of aluminum will shrink considerably, and there is little choice between them in this respect. If aluminum patterns are wanted it will be necessary to make a *master pattern* from which to cast them, and this pattern must allow two shrinkages; one for the pattern, and another for the casting to be made from this metal pattern. The following alloy can be used for this purpose:

ALUMINUM ALLOY

Copper	8 pounds
Aluminum	92 "

The patternmakers allowance for shrinkage for the above alloy is 0.186 inch per foot, and this allowance must be made on the wood pattern in addition to the regular allowance for the shrinkage of the casting. The following white metal alloy shrinks so slightly that the rapping will allow for it, and the casting made with it will be of the same size, as the pattern. This alloy follows:

WHITE METAL PATTERN ALLOY

Tin	55 pounds
Zinc	45 "

Softener for Aluminum

We would like to learn of a metal to mix with No. 12 aluminum alloy in order to make it more soft.

If No. 12 aluminum alloy is too hard for the purpose to which it is put, probably pure aluminum would be satisfactory. Pure aluminum, that is, commercially pure aluminum, can be obtained with the same facility as the alloy mentioned. If pure aluminum is too soft, it can be hardened easily by melting it with various proportions of No. 12 aluminum; thus it might be that a melt of one half pure aluminum and one half of No. 12 aluminum would prove satisfactory and we suggest that this experiment be made.

There is no metal that can be added to No. 12 aluminum to soften it, or make it machine easier, that has the same effect as lead on red brass for instance. The addition of zinc will make it file easier and if this is what is meant by the term softener, it would be advisable to try the addition of zinc.

Rail Rates Take Toll on Foundry Sand

Transportation Forms a Large Part of the Cost of Molding and Silica Sands to the Consumer—The Increase Over 1914 Constitutes a Heavy Fixed Charge

DURING the period just passed, with a sellers' market existing in all lines, foundrymen have had little cause to exhibit more than a slight interest in the increased freight rates. True the effect has been felt by some in the increased costs of metal, fuel, refractories and sand; but with castings in strong demand, it had been easy to cover the increased costs in the selling price of the finished products. Then, as the reaction set in last fall, the falling market on raw materials served to offset the increase in rates which had gone into effect only a short time previously. More recently the slump in business has so affected the foundries that the volume of incoming shipments has not been sufficient to emphasize the effect of the high rates upon existing prices of raw materials.

The effect of the freight rates in sustaining pig iron prices was noted in an article by C. J. Stark, appearing in the Feb. 15 issue of THE FOUNDRY. The same influence is evident in every piece of equipment, and every class of material which during its process of preparation is shipped about the country. That the railroads also take toll directly from the foundries for the molding sand used, has been appreciated; but in the near future, when business revival brings keen competitive conditions it will be much more evident. Foundrymen who are forced to bid sharply for every pound of work, cannot but be affected by the direct charge laid by the railroads upon every ton of sand which they use. Shops which require certain grades of sand possessing properties which render them peculiarly fitted for special castings will be placed at a disadvantage as compared with foundries which are located closer to the pits where these grades are produced. Further, the aggregate cost of sand to foundries throughout the country will be much larger. With the return of the competitive conditions of 1914, many foundries will be hampered by fixed charges still existing upon a 1920 basis.

Transportation always forms a large part of the cost to the consumer of a bulky commodity such as molding sand. While producing costs, including the labor and equipment required to load sand from the pits have advanced during the past six or eight years, the price of sand has been affected even more strongly by the advance in freight rates. Table I which shows the freight from the Canton, Huron and Zanesville districts in Ohio to large foundry centers of Ohio and Pennsylvania, and to Detroit, will serve to illustrate the various advances which have been made. In October, 1914, an advance of 5 per cent was made. In May, 1918 another 15 per cent was added. In June another advance was made. This latter amounted to a flat increase of 1 cent per hundred pounds, or 20 cents a ton regardless of the haul. It was followed last August by another raise of 40 per cent. It will be noted that these increases have totaled over 110 per cent of the freight rate in the early part of 1914. An average of the increases between 1914 and the present rate shows that $1 a ton has been added in the district mentioned.

This average increase may be taken as a minimum in showing the effect throughout the country because a short average haul is represented. It represents the rates upon shipments from some of the largest producing centers to some of the largest consuming points. Further, except for a few instances where special grades of sand are brought from remote points, the shipping distances probably may be taken as the average existing throughout the country.

To some foundries the difference of $1 a ton may not constitute a large item of expense; but to others it may represent in the near future the deciding difference of a fraction of a cent per pound which may lose them attractive business.

Accepting the difference of $1 a ton, the effect upon the cost of all

Table I

Increases in Freight Rates on Sand from Canton, Huron and Zanesville Districts

	Normal rate			5 per cent increase Oct. 26, 1914			15 per cent increase May 1, 1918			20-28 per cent increase June 25, 1918			40 per cent increase Aug. 26, 1920		
	Per ton														
To	Canton	Huron	Zanes	Canton	Huron	Zanes	Canton	Huron	Zanes	Canton	Huron	Zanes	Canton	Huron	Zanes
Cleveland	$0.60	$0.60	$0.85	$0.63	$0.63	$0.89	$0.70	$0.70	$1.00	$0.90	$0.90	$1.20	$1.26	$1.26	$1.68
Cincinnati	1.30	1.15	1.10	1.36	1.21	1.16	1.60	1.40	1.30	1.80	1.60	1.50	2.52	2.24	2.10
Detroit	1.10	1.00	1.10	1.16	1.05	1.16	1.30	1.20	1.30	1.50	1.40	1.50	2.10	1.96	2.10
Toledo	1.00	0.60	1.00	1.05	0.63	1.05	1.20	0.70	1.20	1.40	0.90	1.40	1.96	1.26	1.96
Erie	1.20	1.25	1.40	1.26	1.32	1.48	1.40	1.50	1.70	1.60	1.70	1.90	2.24	2.38	2.66
Pittsburgh	1.00	1.20	†1.10	1.05	1.26	1.16	1.20	1.40	*1.30	1.40	1.60	1.40	1.96	2.24	1.96

*Sand loam $1.20.
†Molding sand $1.00.

Table II

Molding Sand Produced in the United States, 1910-1919

Year	Quantity (short tons)	Value	Average price per ton
1910	3,636,167	$2,431,254	$0.67
1911	3,376,717	2,132,469	.63
1912	4,485,380	2,718,726	.61
1913	3,563,583	2,230,217	.63
1914	2,751,209	1,756,383	.64
1915	3,585,746	2,123,203	.59
1916	4,662,649	3,219,839	.69
1917	4,660,968	4,303,809	.92
1918	4,910,178	5,121,865	1.04
1919	3,774,612	4,153,990	1.10

the molding sand produced is evident from a study of Table II, which gives the molding sand production figures prepared by the United States geological survey. The production figures for 1920 are not yet available, but undoubtedly will surpass those given for 1919 and probably those shown for 1918. The 1919 total was affected by the steel strike, and previous to that time, the total of 4,910,178 tons produced in 1918 constituted a high mark.

An average of 4,345,362 tons of molding sand was produced during the last six years recorded. With the increase of $1 a ton taken as an average, the foundries of the country under normal operation would pay over $4,000,000 a year more for freight on their sand than during 1914.

Prices on both molding and silica sands have been increased during the period under consideration. Gray-iron molding sand has advanced from $1.25 to $3.00 or $3.50 a ton at the pit. Silica and sand-blast sands also have sold at a much higher figure. These prices have been reduced in the past few months. Molding sand unlike silica sand take an additional charge of 75 cents a ton during the winter months. This charge is removed on April 1 and on that date an additional reduction of 50 cents a ton was made by a number of producers.

The average price of molding sand from year to year is shown in Table II. It should be noted that there are many low-cost pits which sell sand at 50 cents or less a ton, and this serves to make an exceptionally low average price. The average price of Ohio sands for 1919 was $1.65 a ton. This average probably will be much higher for 1920. The increase in freight rates again assuming $1 as an average will be at least 50 per cent of the cost of the sand at the pit.

Although the increased transportation cost is assessed directly against the foundries, sand producers, too, will feel the effect when manufacturing again is resumed at normal rate. Those pits more remote from the foundry centers will be at a disadvantage. The difference in costs will influence many foundries to investigate the treatment of nearby sands to adapt them to their needs. Further, the subject of revivifying and reusing sand will recommend itself to the shops which are seeking every means to reduce costs.

Table III

Molding Sand Produced in the Six Leading States in 1918 and 1919

	1918			1919		
States	Quantity (short tons)	Value	Average price per ton	Quantity (short tons)	Value	Average price per ton
Illinois	885,617	$658,205	$0.74	482,219	$338,893	$0.70
Indiana	298,934	135,605	.45	572,292	243,199	.42
New Jersey	442,007	626,637	1.42	501,583	583,656	1.16
New York	519,681	770,512	1.48	418,319	609,730	1.46
Ohio	857,481	1,493,541	1.74	689,555	1,137,356	1.65
Pennsylvania	1,158,715	953,886	.82	512,862	712,460	1.39

Correcting Flaws in Metals and Mixes

Problems of the Gray-Iron, Malleable and Steel Foundry Discussed

By H. E. Diller

Determining the Kind of Pig Iron Required

Question—We are starting a foundry to make special castings. Some of these castings made by another foundry showed 3.35 per cent silicon, 0.108 per cent sulphur, 0.60 per cent phosphorus and 0.55 per cent manganese. As this grade of metal gives satisfactory results we would like to duplicate it and desire to know what kind of iron and coke to order.

Answer—In ordering the pig iron you would first have to determine how much silicon it should contain. To secure 3.35 per cent silicon in the metal the cupola charge would have to have an average content of 3.60 per cent silicon, as 0.25 per cent will be burned out in melting.

Now it is probable you will have approximately 35 per cent of scrap in the mixture. For a 1000-pound charge you would need 1000 x 3.60 or 3600 points of silicon in the mixture. The 35 per cent scrap with 3.35 per cent silicon would give 350 x 3.35, or 1172.5 points silicon. There are then left 3600—1172.5, or 2427.5 points. As there is 650 pounds of pig iron to furnish this, the pig iron must contain 3.73 per cent silicon. Either pig iron can be secured with this amount of silicon or a lower silicon iron can be ordered and the deficiency in silicon made up by adding ferrosilicon to bring it to the required point.

The standard specification of less than 0.05 per cent sulphur in the pig iron should be required. Then brands of pig iron which will give as an average the same amount of phosphorus and about 0.20 per cent more manganese than is required in the castings. The extra amount of manganese will allow for the amount lost in melting the pig iron and remelting the scrap. This amount varies but the figure given should give an ample margin.

Either 72-hour foundry coke or certain by-product coke may be ordered. Both of these grades should be purchased under a specification requiring not more than 1 per cent sulphur and less than 12.5 per cent ash.

Analysis Would Prevent Hard Iron

Question—We make small gray-iron castings with thin sections which must be free from blow holes and above all drill and machine easily. We have for many years used No. 1 foundry pig iron and have insisted that its sulphur content never be higher than 0.03 per cent. With this pig iron we sometimes use as high as 50 per cent of our own scrap but never use foreign scrap. Lately we have been obtaining castings which it is next to impossible to drill. Some of the No. 1 pig iron seems much more close grained than other shipments. How should we mix this iron to get soft metal in the castings.

Answer—It is difficult to know how best to mix the iron unless there is an analysis of the metal available. For this reason we believe it would pay you to have your metal analyzed and see that the iron comes from the cupola with between 2.4 and 2.7 per cent silicon. If you get under this amount, you lose money through more expensive machine

operations and if higher than the upper limit, you pay an excess for the extra silicon in the iron. Whether the No. 1 iron is coarse grained or fine grained would depend somewhat on the temperature at which it came from the blast furnace and the rate at which it was cooled. If the composition of the pig iron were the same you would not need to care whether it appeared to be closer grained or not.

In your present situation, you could soften the metal by securing ferrosilicon and adding some of this to each charge. You should add enough so that the silicon in your metal is between 2.40 and 2.70 per cent; but as you are not having your iron analyzed, you will have to add an estimated amount, say 50 pounds of 8 to 10 per cent to 1000 pounds of metal in the charge. If the iron from the cupola then does not get soft, this amount will have to be increased.

We note that you are securing iron below 0.03 per cent sulphur. This is well if you are not paying a premium for it; but if you are only using your own scrap in the mixture you should not pay a special price for a guarantee of below 0.03 per cent sulphur in the iron, as the normal guarantee of 0.05 per cent sulphur maximum should be satisfactory.

Malleable Specifications

Question.—We recently have been having trouble with malleable iron castings which we buy for railroad work. Two of these castings were analyzed before being annealed and showed the following composition:

Silicon	Sulphur	Manganese	Combined carbon
1.14	0.045	0.38	2.88
0.97	0.043	0.36	2.82

We will appreciate it if you will tell us whether the analyses given show a good grade of iron, and also if you will write a specification under which we could purchase our malleable iron castings.

Answer.—The combination of comparatively high silicon, manganese, and combined carbon shown in the analyses which you give would not produce the best grade of malleable iron and would cause the metal to tend to gray iron in the heavier sections of the castings. As a user of malleable iron you are slightly, if at all, interested in the composition of the iron as long as you get castings which are strong and easily machined. For this reason we would recommend that you purchase castings according to physical properties and pay no attention to the composition of the metal. Such a specification, covering castings for railroad work, has been adopted by the American Society for Testing Materials and copies of it may be obtained at a small charge by applying to the society, University of Pennsylvania, Philadelphia.

Charging Speigeleisen

Question—How does the melting point of spiegeleisen compare with that of pig iron, and should it be put on the pig iron or on the scrap of the cupola charge?

Answer—Spiegeleisen melts at approximately the same temperature as pig iron. As it is desired to mix the manganese well into the charge, it is better to put the spiegeleisen directly above the pig iron and before the iron scrap is put in. This causes the spiegeleisen to melt in the middle of the charge and gives the manganese a chance to work through the mixture of the melted metal.

Properties Ascribed to Semisteel

Question—We would be obliged to you if you would give us particulars regarding the chemical and physical characteristics of what is known as *semisteel*. Can this be made so it will take a slight set or bend without putting it through the malleablizing process? Is there any better melting medium for semisteel than the cupola?

Answer—This name, semisteel, covers practicaliy every grade of cast iron which has been melted with the addition of from 1 to 50 or even 60 per cent of the steel in the mixture. The name therefore is rather indefinite, but is used for want of a better one. The chemical composition will vary according to the work it is to be put into. Practicaily the same laws in regard to its composition will hold as govern cast iron. If heavy-sectioned castings are to be made, the silicon will be low, and conversely, it will be high when thin-sectioned castings are to be made. No standard specifications have been adopted for its physical properties. First class semisteel will have a tensile strength of more than 30,000 pounds per square inch, and the transverse strength on the arbitration bars of the American Foundrymen's association and the American Society for Testing Materials should not be less than 3500 pounds.

We have seen semisteel which when carefully handled and in thin sections would bend 90 degrees and take a permanent set there but we do not believe it would be commercially practical to try to make semisteel which would take any great deformation.

This metal was made from a mixture of 12 per cent steel scrap, 33 per cent scrap iron from the same mixture, 25 per cent warm-blast charcoal iron and the remainder coke pig iron. The composition was approximately, silicon, 1.75 per cent; sulphur, 0.090 per cent; phosphorus, 0.450 per cent; manganese, 0.80 per cent; total carbon, 3.25 per cent. It was melted in a cupola. We have also seen cast iron in an English automobile cylinder foundry which would take quite a noticeable set.

We believe the best grade of semisteel could be made in the electric furnace as more perfect control of the composition and pouring temperature could be secured with this instrument. However, it must be realized that to get the best results from the electric furnace the operator must understand metallurgy and furnace operation.

Air furnace iron is generally considered to be somewhat better than cupola iron although this contention is disputed and the air furnace is not used to any great extent in the gray-iron industry except for making metal for rolls and other large castings. Here its advantage is that a large amount of metal can be tapped at one time and the composition of the metal is more uniform and homogenous.

Iron for Light Sections

Question.—We wish to know the best grade of iron for producing castings similar to those used on cash registers, adding machines, etc. The castings should machine well and have a smooth surface. Please tell us the kind of sand to be used for such work and where it can be secured.

Answer.—The iron used for castings such as you mention should be soft and should flow readily. To secure these properties a high-silicon and fairly high-phosphorus iron is necessary. The iron as it comes from the cupola should contain 2.25 to 2.50 per cent silicon, approximately 0.90 per cent phosphorus, 0.50 to 0.80 per cent manganese, and the sulphur should be kept fairly low, not being allowed to get much higher than 0.10 per cent.

To secure such an iron, a mixture should be made of pig iron and your own foundry scrap. The pig iron should be ordered with 2.5 to 3 per cent and less than 0.05 per cent sulphur, and with manganese and phosphorus as already given for the castings. Should you find difficulty in securing pig iron of this high silicon, enough ferrosilicon —8 to 15 per cent ferrosilicon—could be added to the mixture to bring the silicon content of the finished iron to the amount desired.

A fine open sand such as is used for stove plate and piano plate would give good results for work such as you make.

Anneals Malleable Iron with Oil Fuel

Coal-Burning Ovens Easily Changed for Burning Oil and Can Be Converted Back Again Quickly if Necessary—Oil Is a More Expensive Fuel but Requires Less Labor in Handling and Firing

WILLIAM F. HOERNKE

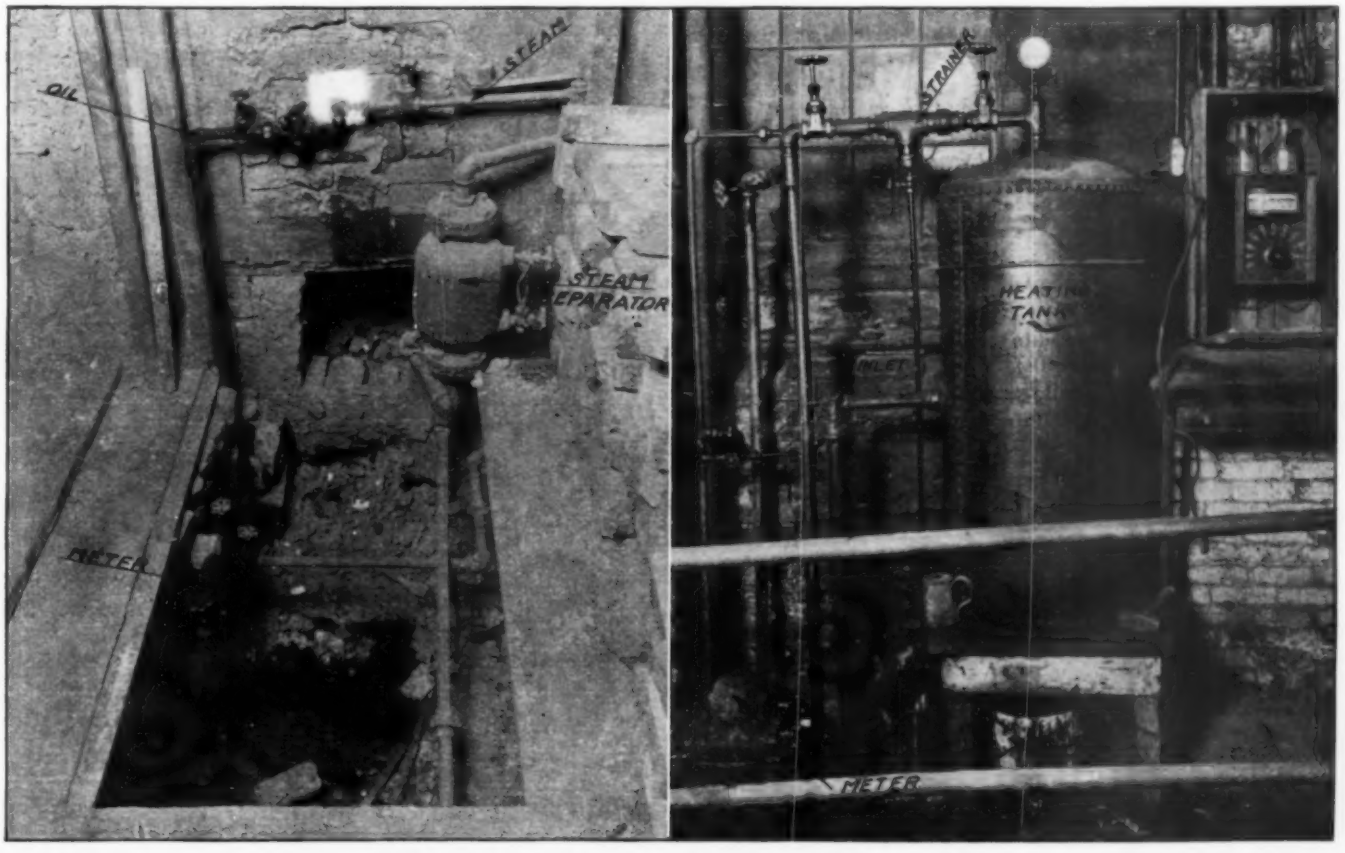
COAL has been generally used for annealing malleable iron since the industry began. Other fuels have been tried and it is reported that as much as 30 years ago one firm experimented with oil. A company in the East has been using oil continuously for over 10 years. But in spite of an attempt here and there, coal as a fuel for annealing, has not been displaced to any great extent. However, about four years ago, due to an increased knowledge of how to use liquid fuel, to the development of better apparatus for applying it, and to the difficulty of securing coal on account of war conditions, several firms tried oil, and some of them continued to use it. The handicaps which prevented more general use of oil were undoubtedly the cost, its uncertain supply, and the expense of the tanks and equipment required. Also, many companies had neither compressed air nor steam, one of which would be necessary to atomize any liquid fuel.

The Stowell Co., Milwaukee, was in a good position to experiment with oil as an annealing fuel, because it possessed an oil tank of 10,000 gallons capacity and had been burning oil for some time on its core ovens. In changing from coal to oil, the firebox of the annealing ovens was altered. It was not an expensive change and was made by two men in a few hours. The gratebars were left in. The firebox area was 9 feet in length by 2 feet in width. The gratebars were first covered with two courses of firebrick. An opening 4 inches wide, and extending about half the length of the firebox was left at each side to furnish draft. Starting about half way from the front end of the firebox where the burner is located, additional courses of brick were laid, like steps, to form a baffle for the flame. This baffle is about 2 feet high at the back end of the firebox. Silica sand to a depth of 2 inches was then put on the baffle which protects the brick.

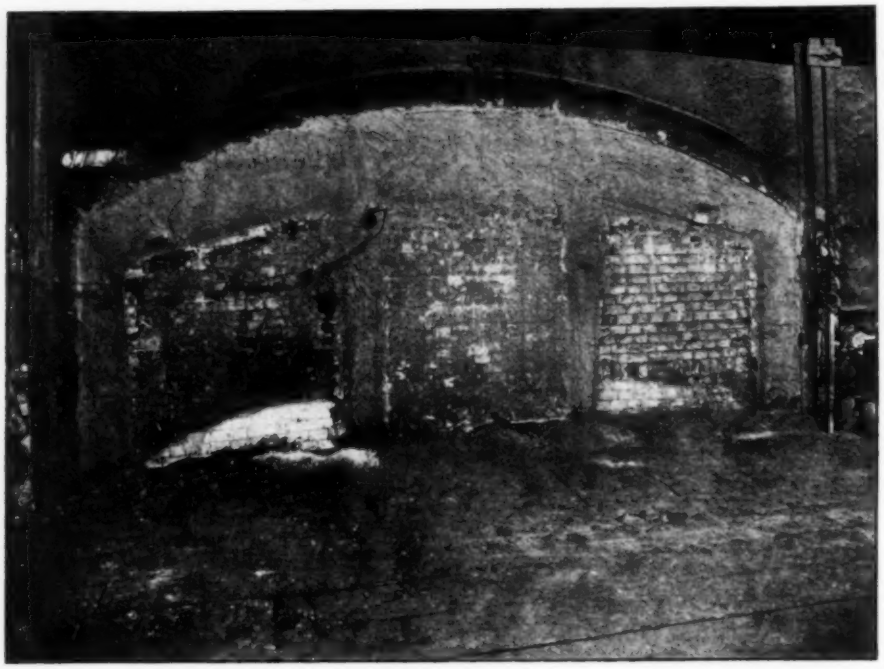
The firedoor was bricked up, leaving an opening 4 inches square on the outside, flared to 8 inches square on the inside. This forms a combustion chamber which gets red hot and keeps the flame lighted in case the oil supply or pressure is not steady. The opening is 2 inches above the brick floor of the firebox. The ash-pit door was loosely bricked up and the draft is controlled by adding or removing brick. The burner is mounted in the center of the 4-inch opening, and in line with the outside wall.

The oil line from the oil-supply tank passes through a small tank fitted with a strainer and heating coils. The oil is pumped at a pressure of about 25 pounds. The line is supplied with a meter and the necessary valves. Either

Paper read at a recent meeting of the Milwaukee Malleable club by William F. Hoernke, foundry superintendent, the Stowell Co., Milwaukee.



FIREBOX SHOWING LOCATION OF THE BURNER, METER AND STEAM SEPARATOR—TO THE RIGHT—ILLUSTRATION OF THE TANK AND FITTINGS FOR PREHEATING THE OIL



FRONT OF THE OVEN WITH THE DOORS BRICKED AND LUTED—NOTE THE OIL BURNER TO THE EXTREME RIGHT

steam or air can be used to atomize the fuel oil. Steam is used at one of the plants of the Stowell Co., and air is employed at the other. Steam is under a pressure of 80 pounds per square inch and air at a pressure of 60 pounds. If the steam at the oven is not dry it is necessary to put a water trap just before the burner. The reason steam is used at one plant is that the compressed air supply is inadequate.

At first the ovens were equipped with two burners to an oven but it was found that one burner of the half-inch size was enough. The burners were furnished by W. N. Best, Inc. New York.

To start the burner, it is first heated with a flame from some waste and wet with some kerosene before any valves are opened. Next, the atomizer valve is opened slightly. This blows the flame from the burning waste into the combustion chamber. Then the valve on the oil line is opened fully and the oil is carefully turned on by means of the oil regulating cock.

Mixture Is Important

Some experience is needed to get the right mixture of oil and air, and as this is acquired a saving in the amount of oil required will be noticed. There should never be more than a faint smoke coming from the top of the stack. If no smoke comes from the stack too much air is probably being used, which tends to cool the oven. A heavy smoke indicates too much oil in proportion to the air supplied, giving incomplete combustion.

When the oven reaches the annealing temperature the flame can be cut down by turning off the oil and the air or steam. For the two hours after the burner is started the damper is left wide open, then it is closed half way and left at this point until a temperature of 1600 degrees Fahr. is reached. It is then closed to a 2-inch opening.

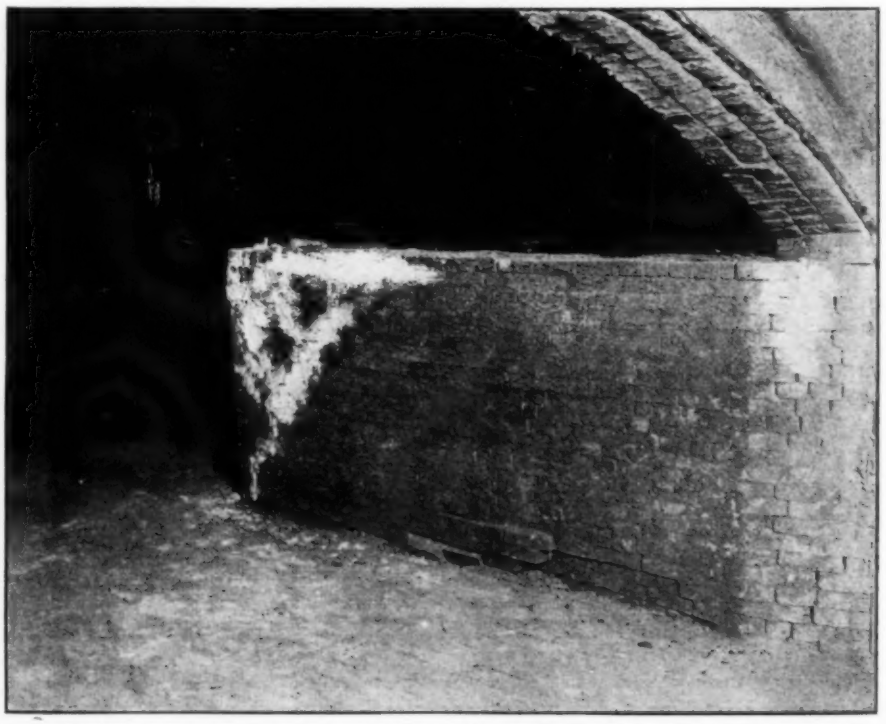
Tilt Burners to Regulate Heat

Pyrometers are placed in the front and back of the oven, about 4 feet from the floor. If either pyrometer shows a higher temperature than the other the irregularity of temperature can be corrected by tilting the burner slightly up or down.

Ovens have been brought to temperature in 18 hours, but this practice is not recommended. Our average time for bringing an oven to temperature is about 30 hours. The ovens are held from 70 to 75 hours, counting time when the temperature reaches 1500 degrees Fahr. The burner is then shut off, first turning off the oil, and then the steam or air, after which the burner is tilted up away from the opening which is bricked and mudded shut. The opening below the grates is also bricked up and mudded, and the draft damper is closed tight. The oven remains in this condition until it reaches a temperature of 1000 degrees. The average rate of cooling is a little less than 7 degrees per hour.

Compensating Features

The use of oil as a fuel has many advantages which must in some instances make up for the higher cost of the fuel or no one would continue to use it. One advantage is the saving of labor. Formerly a fireman and an engineer were employed and part of a laborers time was required to wheel ashes and coal on the day shift, and one man's full time was needed at night. One man is now used as fireman and engineer and the laborer on the day shift has been dispensed with. Also the night man is able to do extra work that does not take him away from the ovens for long at a time. A saving in the annealing pots is effected. The amount of this saving may be estimated by the fact that three or four wheelbarrow



THE INSIDE OF THE OVEN LOOKS LITTLE DIFFERENT FROM WHAT IT DID WHEN IT WAS FIRED WITH COAL

loads of scale were taken from every oven after an anneal when coal was used whereas now less than one wheelbarrow load of scale is taken from an oven. The grates which were used before are not required. When coal was used the flues had to be cleaned about every six months. The ovens now are operated for from 18 months to 2 years before it is necessary to clean the flues. Should it at any time be impossible to secure oil it would take only a short time to equip for burning coal.

Considering everything the Stowell Co. feels the choice of oil as a fuel for annealing has been justified, and from an operating standpoint would not willingly change back to coal burning.

British Malleable Iron Practice Differs

BY H. A. SCHWARTZ

WHILE the article by F. H. Hurren on "Experiments on Cupola Malleable," published in THE FOUNDRY of Feb. 15, 1921, is a most interesting exposition of certain observations in British malleable practice, it is likely to be misinterpreted by the American reader unless the distinction is made between British and American practice.

The well-known English writer, Hatfield, says:

"The materials used in Britain in the production of malleable castings * * * are high in sulphur * * * this element insists upon a some what lengthy anneal at fairly high temperatures with a view to bringing about malleablizing largely in decarburization.

"These remarks apply also * * * to the practice in France, Switzerland, Belgium and Germany."

This is a very different process, in principle as well as in results, from American malleable made from low-sulphur material and malleableized by converting the combined carbon of cementite into free temper carbon. British malleable, according to Hatfield, contains originally 2.80 per cent to 3.50 per cent carbon and various amounts of the other elements as given in Mr. Hurren's analyses. All these determinations show a typically low manganese, ranging from 0.04 per cent to 0.13 per cent, except when raised in the experiments with steel additions. They also show a typical high sulphur content, varying from 0.22 to 33 per cent in this element. The effect of this anneal, which was carried out at from about 590 to 1000 degrees Cent. for from 72 to 120 hours, has been to reduce the total carbon to between 2.96 and 1.25 per cent, depending on experimental conditions. From 0.57 to 2.68 per cent carbon was left in the combined state, the remainder being free, or temper carbon. A typical annealed iron under American practice would contain carbon, 2.50 per cent; silicon, 0.70 per cent; manganese, 0.28 per cent; sulphur, 0.06 per cent; phosphorus, 0.19 per cent. This would be converted by annealing into a metal having a total carbon of 1.75 per cent and a combined carbon of 0.10 per cent.

It will be seen that while the British product occasionally may contain amounts of free carbon as great as found in American practice, it always contains a much greater percentage of combined carbon than any malleable iron encountered in this country. This is due to the high content of iron sulphide, which entirely prevents the complete breaking up of combined carbon, even under severe temperature conditions.

Mr. Hurren's micrographs show this combined carbon, as pearlite, occupying a large part of the metallic area in each of his fields. It is the presence of this pearlite which imparts to British malleable its characteristic strength of around 60,000 pounds per square inch and its characteristically low elongation of 5 per cent and under. The product corresponds in properties closely to under-annealed American iron, which as properly manufactured has a tensile strength of about 50,000 pounds per square inch, and an average elongation of 10 to 12 per cent.

To this pearlitic structure the material also owes its *steely* fracture, from which the name *white heart* malleable is derived. To get high ductility the only recourse under European conditions is to decarburize almost completely, an end impossible of attainment in heavy sections.

In America the freedom from combined carbon is attained by a process of graphitization, not necessarily accompanied by any decarburization. This process takes place throughout the mass and can be applied to pieces of almost any size.

*The author, H. A. Schwartz, is manager of research, the National Malleable Castings Co., Cleveland.

Issues List of Cost Books

The National Association of Cost Accountants, 130 W. 42nd St., New York, has issued as Volume II No. 10 of its official publications, "A Bibliography of Cost Books." This bibliography probably contains the most complete list of cost books which has been published in this country. It is limited to books, it being the intention to cover pamphlets and other material in a supplementary bibliography to be issued later.

The bibliography is divided into five sections; one containing books devoted to the general field of costs; one to books on accounting and auditing which contain sections dealing with costs; one to books on industrial engineering with sections on costs; one to books on costs for particular industries, this section being divided into the leading industries; and one dealing with special phases of cost accounting, such as overhead, depreciation, etc. In all, about three hundred and fifty titles are listed.

The association has a few extra copies of this bibliography which are available to nonmembers at 75 cents each.

Sash Weight Rigging

Question:—We are contemplating going into the manufacture of sash weights and as we are not familiar with that class of castings we should appreciate any information you could give us on the subject. We should like to have advice on the best rigging and equipment required to produce these goods on an economical basis.

Answer:—Sash weights can be made in many ways and the method adopted will depend greatly upon the tonnage you propose to handle and, to a certain extent, on the class of available labor. Under ordinary circumstances, a double, hand squeeze, stripping plate machine would be the most suitable form of molding device. The machine could be duplicated on as many floors as the exigencies of the business demanded.

We should advise you to get in touch with any of the molding machine manufacturers listed in the advertising pages of THE FOUNDRY. Lay your proposition before them, giving full details of your proposed daily output and they will quote you on suitable equipment for doing the work.

George A. Brady has been appointed Massachusetts representative for Frederic B. Stevens, Detroit.

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Cheap Scrap Favors Synthetic Iron

PRODUCTION of synthetic cast iron is interesting many foundrymen in an academic way. Data at hand enable the foundryman who wishes to make this product to determine closely the cost per ton of output of operating the electric furnace and he need only determine the price of raw materials to show whether the process would be a profitable venture. The cost of electrical melting is undoubtedly higher than the cost of cupola melting and the only possible way in which synthetic iron could be made cheaper than cupola iron is by using cheaper stock. At present the cheapest grade of scrap available is machine shop steel turnings; or if the cost of the ferrosilicon necessary to add to steel to produce synthetic gray iron is added the cost of cast iron borings probably would be a little lower even than the machine shop steel turnings. Of course, present prices can not be used as a criterion for future prices, but an average for a number of years as given by the *Daily Metal Trade* shows that these two grades of scrap average approximately the same price. This is about $6 a ton below the price of heavy melting steel scrap. Prewar prices of these grades of scrap varied little from $6 a ton but during the war this price rose with the price of all other commodities, until, in the summer of 1917, the prices of both grades of scrap were approximately the same at a fraction under $24 a ton. Since then these prices have fallen rapidly until now, in some centers, the prices quoted are back to $6 a ton. Compared to this low price No. 2 foundry pig iron is quoted at $26 to $27 at Cleveland. This is enough of a spread to cause interest in the electric process.

Fluxes Sulphur in Cupola with Lime

THE increased sulphur content of the scrap iron used in gray-iron foundries coupled with high sulphur coke is accentuating the sulphur problem to such an extent that the metallurgist is beginning to search for means of lowering the sulphur in gray iron. The electric furnace is being advocated as a melting medium because the metal in this process does not come in contact with fuel and so does not acquire sulphur during melting. However, the cupola has so many advantages in the way of low first cost, operating cost and continuous melting that efforts are being made to accomplish similar results by this process. One method advanced is to substitute oil, practically free from sulphur, for a portion of the coke. This has proved capable of keeping down the percentage of sulphur to some extent. Other means are being tried. A method advanced by A. C. Porter is published in this issue of THE FOUNDRY. Mr. Porter describes interesting results obtained by increasing the amount of lime charged in the cupola. As is pointed out in the article, expert knowledge of the principles of cupola melting is required to use the process because the increased weight of slag introduces complications in heating the metal and in drawing off the slag. Encouraging results have been obtained and more general experimentation may develop further facts to make this process more practical. The process shows the possibility of securing iron from the cupola with a reasonably low sulphur content and when the sulphur menace becomes too serious, this method may offer a better basis for the cupola to compete with the electric furnace.

Trade Outlook in the Foundry Industry

FROM early indications, during the first few days of April, March has established the low point in the curve of industrial activity. Foundries throughout the country operated at a low percentage of capacity or were closed entirely. Raw materials, iron, coke, sand and nonferrous metals were sold only in exceedingly small lots, and production was at a low ebb. While nothing tangible has occurred to better conditions, a slight improvement is noted in contributing factors which indicate better prospects. Foundries are purchasing iron in slightly larger volume and activity again is resumed among some large consumers of castings.

Relief is Sought

The railroad situation is characterized as the key log in the jam which is holding back the industrial stream. Freight rates are so high as to discourage the shipment of all classes of merchandise, and to localize business to a degree never before experienced. At the same time absolutely no purchasing of new railway equipment, which admittedly would do much to accelerate the castings business, is possible until the financial tangle which involves the roads is eliminated. It is estimated that while the railroads now can meet the requirements of the country, under normal activity, they would require an aggregate of 200,000 more freight cars, 10,000 more passenger coaches and more than 8,000 new locomotives, in addition to track and terminal facilities. These figures are contained in a recent report of the Calder committee. Even the ordinary repairs are far in arrears. A recent report of the car service division of the American Railway association showed that of the 64,781 freight, passenger and switching locomotives on the lines, March 1, 12,077 or 19 per cent needed repairs consuming more than 24 hours.

Prices of Raw Materials for Foundry Use

CORRECTED TO APRIL 7

Iron		Scrap	
No. 2 Foundry, Valley	$25.00 to 26.00	Heavy melting steel, Valley	$12.50 to 12.75
No. 2 Southern, Birmingham	23.00 to 25.00	Heavy melting steel, Pitts.	13.00 to 14.00
No. 2 Foundry, Chicago	25.00 to 27.00	Heavy melting steel, Chicago	11.00 to 11.50
No. 2 Foundry, Philadelphia	25.34 to 28.54	Stove plate, Chicago	15.50 to 16.00
No. 2 Foundry, Buffalo	26.00 to 28.00	No. 1 cast, Chicago	15.50 to 16.00
Basic, Valley	23.00 to 25.00	No. 1 cast, Philadelphia	18.50 to 19.50
Basic, Buffalo	27.00 to 29.00	No. 1 cast, Birmingham	17.00 to 18.00
Malleable, Chicago	25.50 to 27.50	No. 1 cast	17.00 to 18.00
Malleable, Buffalo	26.50 to 28.50	Car wheels, iron, Pittsbgh.	18.00 to 19.00
Coke		Car wheels, iron, Chicago.	14.00 to 14.50
Connellsville foundry coke	$4.50 to 5.50	Railroad malleable, Chicago	13.50 to 14.00
Wise county foundry coke	6.50 to 8.50	Agricultural mall., Chicago	13.50 to 14.00
		Rilroad mall., Buffalo	12.50 to 13.50

Some Auto Demand

Some of the larger passenger automobile establishments have increased their operations. These are specifying against castings which in many cases already have been made and were held on delayed order for several months. The automotive activity up to the present seems to be actuated by seasonal demand, and it is not evident to any considerable extent in either the truck or tractor branches of the industry. That the automotive industry still is uncertain as to the future is apparent. One large manufacturer specified for May, June and July delivery of cast steel wheels, and within a week canceled the order. In the East, foundry operations are spotted. Through New England, the revival which was noted some weeks ago has been succeeded by a slump in operations and retrenchment of buying that has brought a new low point in activity. A few individual plants in the vicinity of Boston report increases in new orders. Some improvement is noted among machinery jobbing foundries and stove works in southern Ohio, but agricultural implement makers are taking practically no castings. Cast iron pipe inquiry is improving throughout the country, but buying is confined almost entirely to private interests. In the Mississippi valley, foundry business in general is at a low ebb. St. Louis stove shops which recently reopened after several weeks inactivity, again have shut down. In Chicago, Cleveland, Milwaukee and Detroit, the rate of operation probably is as low as 20 per cent of capacity in all foundry lines.

Iron Stocks Low

Except for the New England states, where difficulties of shipment incident to the freight congestion last year forced large accumulations, the stocks of iron on hand in the foundries of the country are at a minimum. It is estimated that with 60 per cent of normal operation, the greater number of the plants through the Central West would not have enough iron to last them two weeks. Practically all buying recently has been confined to car load lots or less. Iron production, according to figures compiled by *The Iron Trade Review*, struck bottom in March. The total for the month was only 1,593,542 tons, the lowest since January 1915. Compared with the February output of 1,929,394 tons, the total last month represents a loss of 335,852 tons. During March, the production of merchant iron totaled only 261,967 tons, which compared with the February total of 338,383 tons gave a loss of 77,416 tons. The daily production affords a more satisfactory basis for comparison. The February daily output of merchant pig iron was 12,085 tons, while the March total was 8450 tons, giving a loss of 3635 tons or 30.3 per cent. March 31 showed 52 fewer stacks in blast than did the last day of February. The 103 blast furnaces in operation at the close of the past month are below the most restricted capacity which was in effect in 1908 and 1914 and in relation to the present total capacity, they represent the smallest percentage in operation since records have been compiled. Coke production has suffered similarly and has fallen to the 1907 level.

Nonferrous Hard Hit

Nonferrous foundries share the general depression. Prices on nonferrous metals based on the *Daily Metal Trade* for April 7, follow: Casting copper, 11.75c to 12.00c; lake copper, 13.00c; lead, 4.45c to 4.50c; Straits tin, 28.37½c; antimony, 5.20c; aluminum, No. 12 alloy, producers' price, 27.30c and open market, 18.50c to 20.50c. Zinc is 4.65c, East St. Louis.

Personal

Martin Behrman has been elected vice president of Stern Foundry & Machine Co., New Orleans.

Ralph S. Cutting, manager of the Champlain Motor Co., has been appointed general sales manager for the Foundry Mfg. Co., St. Albans, Vt.

Arthur L. Hinman has been appointed to take charge of the new office of the Crane Co., Chicago, at 57 Eddy street, Providence, R. I.

John Decthardt, who has been assistant superintendent for the Hercules Gas Engine Co., Evansville, Ind., has been made general superintendent of that company succeeding R. J. McSherry who resigned recently.

Philip T. King, formerly with the Bedford Foundry & Machine Co., Bedford, Ind., has opened offices at 626 Hudson Terminal building, New York, to deal in cranes and contractors supplies. He formerly was with the Ohio Locomotive Crane Co., Bucyrus, O.

William C. Dickerman, vice president in charge of operations of the American Car & Foundry Co., St. Louis, has been elected a director of the United Gas Improvement Co., Philadelphia, to fill a vacancy caused by the resignation of Thomas J. Dolan.

Edwin S. Carmen, Cleveland, president of the American society of Mechanical Engineers, presided at the March meeting of the national council of the society in Boston, March 23. He recently completed a transcontinental tour in the interests of the society.

W. C. Peterson, for the past 12 years in charge of the metallurgical laboratories, heat treating departments and research work, respectively, of the Packard Motor Car Co., Detroit, has resigned to take charge of the metallurgical department of the Atlas Crucible Steel Co. at Dunkirk, N. Y.

Gordon F. Perry, president of the National Iron Corp., Toronto, has sailed from England for Canada to organize a Canadian board of directors for a branch of the English Electric Co. which is to be established in Toronto. Among other activities, Mr. Perry is a director of the Alloy Steel Works, Ltd., and of the Steel & Radiator Co.

William J. Sansom has been placed in charge of the western office of the Wheel Trueing Tool Co., Detroit, which recently was removed from Milwaukee to 20 Jackson Blvd., West Chicago. Mr. Sansom formerly was night superintendent of the Milwaukee works of the International Harvester Corp. and previous to that time was an instructor at the University of Wisconsin.

Howard R. Stevens, 54 Church street, Hartford, Conn., has been appointed representative of the Canton Foundry & Machine Co., Canton, O., the Economy Pumping Machinery Co., Chicago, and other manufacturers.

Charles L. Newcomb, manager of the Deane Steam Pump Co., Holyoke, Mass., a subsidiary of the Worthington Pump & Machinery Corp., will celebrate the fortieth anniversary of his connection with the company on April 21. Officials and employes are planning to take fitting cognizance of the event. Mr. Newcomb is a former president of the New England Foundrymen's association.

R. E. Carpenter, for 15 years connected with the Taft-Pierce Mfg. Co., Woonsocket, R. I., and later with the Aluminum Castings Co., Cleveland, has been elected president of the Hartford Automotive Parts Co., Hartford, Conn., succeeding Jarvis McA. Johnson, resigned because of ill health. L. J. Harley, Jr., was elected vice president. James M. Carney, chairman and general manager, also resigned on account of his health.

Obituary

Robert Johnston, general manager and treasurer of the Bellaire Stove Co., Bellaire, O., died recently at his home in that city.

Walter Wainwright, who for a number of years was connected with the advanced Rumley Co., La Porte, Ind. and previously was foundry superintendent for the Falls River & Machine Co., Cuyahoga Falls, O., was killed in an elevator accident in Cleveland, March 10.

Captain David W. Payne, U.S.A. retired, died recently at his home, 490 Greene avenue, Brooklyn. He was born at Corning, N. Y., in 1841, a son of the founder of the engine building concern of B. W. Payne & Son. While in the army he designed and built the first dredge boat used on the Mississippi and removed the wrecks of the Confederate ships sunk by Farragut at the mouth of that river. He was the editor of *Steam*, the inventor of the Payne automatic engine, and the author of *Foundry Practice*.

Elie Millett, one of the first drop forging manufacturers in this country, inventor of the Millett core oven, and founder of the Millett Brass Co., now the Harley Corp., Springfield, Mass., died at his home in that city, March 20, aged 69 years. He had been identified with the foundry industry more than half a century, his first connection being with a brass foundry in Manchester, N. H. Going from there to Springfield, he was associated with the E. Stebbins Mfg. Co., for more than 30 years. The invention of the Millett core oven was the result of years of study. In 1907 with L. J. Harley, Jr., he organized the Millett Brass Co., which became the largest brass foundry in New England. In 1912 he sold out and the company then was reorganized under the name of the Harley Co.

Acquaint Foundrymen with Brass Association

During the week of April 4 the Metropolitan Brass Founders association maintained a booth at the Brooklyn Industrial show held in the 23rd Regiment Armory, Brooklyn, N. Y. The association at that time inaugurated a campaign for broader acquaintanceship among the foundrymen of the metropolitan district.

Suggests Safety Aids

That the careless piling of castings in the cleaning room is the cause of most accidents in foundries is the contention of W. C. Howe, assistant to the vice president and general manager of the Pressed Steel Car Co. This statement was made by him in an address to approximately 800 safety first men in a meeting at the chamber of commerce recently. This was the eleventh meeting of the western Pennsylvania division of the National Safety council held this winter. F. J. Lanahan of the Fort Pitt Malleable Iron Co. led the discussion and Francis Feehan of the state labor department stated that he was making an effort to have the labor code altered so as to compel workmen in hazardous jobs to wear goggles.

Tells Pittsburgh Foundrymen of Europe

At the March dinner-meeting of the Pittsburgh Foundrymen's association held March 21, D. Robert Yarnall of Yarnall Waring Co., Philadelphia, manufacturer of power plant devices, delivered an address on political, social and industrial conditions in Germany. Mr. Yarnall was affiliated with Herbert Hoover in the organization of relief work in central Europe and devoted considerable time to that enterprise. His address was illustrated by lantern slides. A similar address was delivered by Mr. Yarnall before the Philadelphia Foundrymen's association in January.

Adjustable Flask Guide Is Easily Applied

Developed for use in its own foundry, a new type of flask guide now is being placed on the market by the P. H. & F. M. Roots Co., Connersville, Ind. It is the result of studies by an experienced foundryman in the Roots organization and is designed to reduce rejections of castings caused by shifts, drops, crushes and run-outs at the parting line. These mishaps have appeared to this company as something cutting deeply into profits and their elimination promised stoppage of an important leak. Reduced cost of maintenance is an added gain.

The guide is simple in construction, consisting of four parts: a bracket with the usual V-groove which may be attached either to the cope or the drag; a second bracket with a rectangular slot; a guide of varying length with the end designed to fit in the slot and a flat key or cotter pin to hold it in place.

No bolts, nuts or screws are involved and neither wrench or screw driver is necessary in adjusting this guide pin. It can either be attached or removed by rapping the key with a hammer or for that matter anything that will serve as a hammer. A range of sizes provides a suitable guide for every size and type of flask. Pins of various lengths are interchangeable and the angle shaped bracket can be used as a handle in lifting the flask.

The device prevents the slightest shift in the flask and guides the cope absolutely straight. Rust or sand do not cause the guide to jam or prevent positive adjustment The guide pins may be removed when the molds are closed and clamped thus affording an opportunity for mudding back of

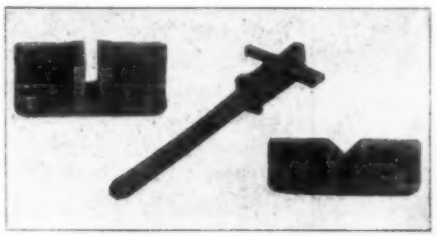


FIG. 1—THE SOCKET, PIN AND GUIDE FOR USE ON SNAP FLASKS OR SMALL FLASKS HANDLED BY ONE MAN

the guides, a precaution which prevents run-outs at this point. With permanent guides or with temporary wooden guides this is impossible.

Guides for large flasks made on the floor are furnished in four sizes with various lengths of pins to accommodate flasks used for different jobs. The pins may be removed without any difficulty and flasks in the storage yard may be piled straight as there are no projecting pins to interfere. This feature also saves the guides from being bent, a fruitful source of trouble with the permanent type. Cost of replacement or repair is a considerable item saved by the use of removable pins.

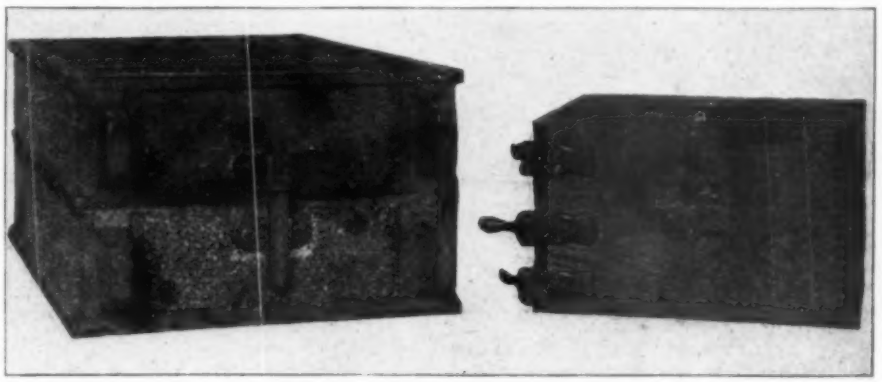


FIG. 3—SHOWING METHOD OF APPLYING THE GUIDE TO LARGE AND SMALL FLASKS

The illustrations show the simplicity of this device and its positive control in insuring a straight lift and an accurate fit. In the case of a snap flask the guides are adjusted

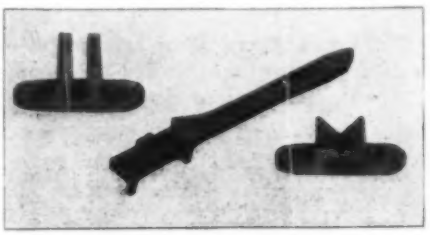


FIG. 2—A SIMILAR OUTFIT FOR USE ON LARGER FLASKS

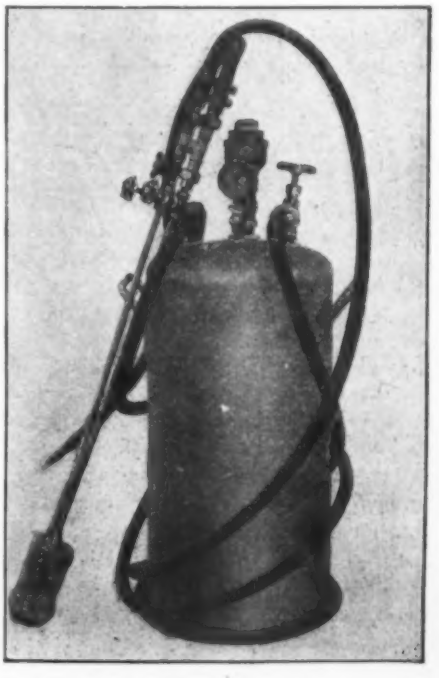
before commencing the day's work and when using individual flasks the guides are adjusted to fit each one thereby securing a perfect and close fit. The guides may be applied to snap flasks, to wooden, cast iron or steel flasks. They also may be attached to match plates used on molding machines and in all cases will assure absolute accuracy and perfect match of the two parts.

Designs Magnetic Switch

For operating electromagnets and at the same time affording protection from heavy inductive kicks, the Ohio Electric & Controller Co., Cleveland, has developed a magnetic switch of the 2-unit type. The two units are a magnetic switch and an operator's master switch, both of which are substantially and compactly built. Three positions are provided on the master switch, the neutral position being with the handle in a vertical position. When the handle is thrown to the left or forward position, the magnet energizing current is on; when thrown to the right or reverse position, the de-energized current is on. In the three successive positions, the controller closes the circuit for lifting the load; opens the circuit, at the same time reducing the arc and kick strain by employing a magnetic blow out and shunting a resistance across the magnet terminals; and reverses the current through limiting resistances for dropping the load quickly. In the magnetic switch all hinged joints are shunted and the resistance is enameled and set in clips in a case mounted back of the controller slate. The resistance may be inspected or replaced by opening the box about a hinge pin running horizontally through the lower part of the

Oil Burner for Shop Use

For general use in machine and repair shops, foundries, ship building



THIS BURNER OPERATES ON CRUDE OIL, FUEL OIL OR KEROSENE

THE GRINDING WHEEL IS KEPT AT THE FRONT BY ADJUSTING THE HOOD

plants and steel car building plants, where compressed air is available, the McKneat Mfg. Co., Easton, Pa., has developed an oil burner for miscellaneous heating. As shown in the accompaying illustration, the outfit consists of an oil tank with pressure gage, the burners and the necessary connecting hose. For fuel the burner utilizes either crude oil, fuel oil or kerosene, whch produce temperatures of 1800, 2500 and 2900 degrees Fahr., respectively. All parts of the equipment have been made to withstand hard usage. For use where compressed air is not available the company manufactures a burner on the vaporizing principle, using kerosene only as fuel. One of the uses for the latter outfit is the thawing out of ore frozen in steel cars.

Foundries in Britain

According to Arthur Smith, formerly assistant controller of the forgings and castings department of the British Ministry of Munitions the number of firms producing malleable iron castings in England during 1917 was between 160 and 170. The number of men employed in the industry was between 7500 and 8000 and the total output per week approximately 1500 tons or an average of 9 tons a week for each of the firms interested.

Commenting on this paragraph, Prof. T. Turner said that the number of firms engaged in the malleable iron industry during 1918 in the United Kingdom remained practically unchanged. For purpose of comparison he stated that the total yearly output amounted to 66,000 tons as against 1,500,000 tons for America. A return compiled in preparation for the inaugural meeting of the British Gray and Malleable Cast Iron association and dated Sept. 30, 1920 indicates that there are 2439 foundries in England; 305 in Scotland and 52 in Ireland or a total of 2796 in the United Kingdom of Great Britain and Ireland.

Heavy Duty Grinder Has Rapid Adjustment

For dry grinding work, the Marschke Mfg. Co., Indianapolis, has designed a heavy duty, ball bearing grinding machine which is capable of rapid adjustment. A feature of the machine is that the hoods covering the wheels are adjustable to bring the grinding wheel always to the front of the hood. Turning the small handwheel, shown in the accompanying illustration, raises and lowers the steady rest and automatically adjusts the spark plate. The wheels are 18 x 3-inch.

The machine shown in the illustration is equipped with an exhaust fan although this detail may be omitted. This exhauster is mounted inside of the base and operated by a high-speed chain drive, the whole device being inclosed in a housing as a protection from dust and grit. The hood support which serves as the outer ell for the exhaust has an opening directly underneath which may be used as a cleanout or may be opened so that when grinding brass, the heavy cuttings may fall through into a container placed below. Starting equipment is mounted on the back of the door only the handle extending to the outside. Opening the door provides accessibility to the blower.

Recording Thermometer Has New Features

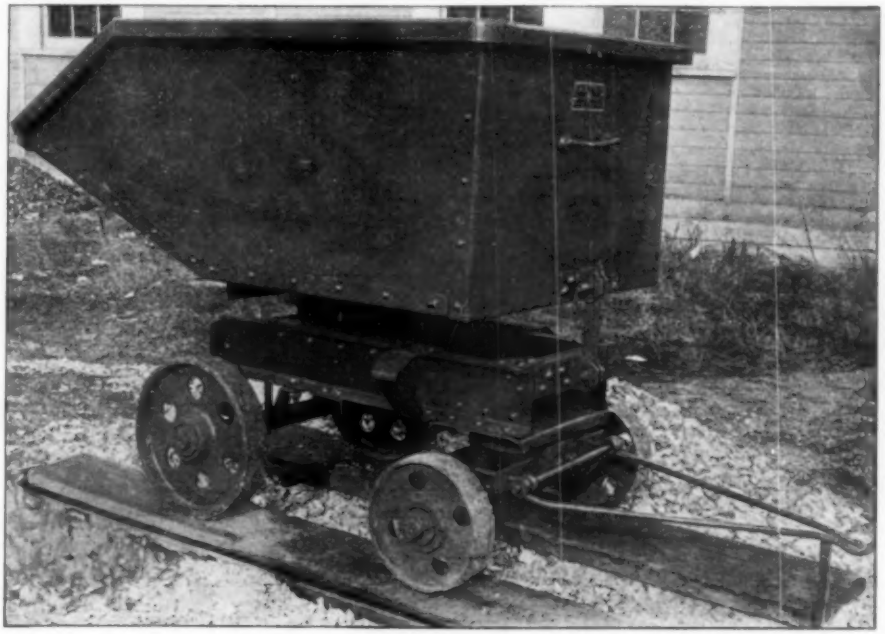
A recording thermometer embodying several new features has been designed by the Brown Instrument Co., Philadelphia, for core ovens, quenching baths and other low-temperature measurements. The charts used with the instruments range from minus 40 degrees to plus 1000 degrees Fahr. Some of the new features are an adjustable pen arm; automatic pen release which lifts the pen automatically when the door is opened; a moisture-proof case; patented chart clips which automatically lock the chart when the door is opened, and an arrangement for adjusting the helix for calibration. An 8-day clock movement is attached to the front plate to keep the clock in alignment at all tinmes with the chart, and to facilitate its removal for cleaning.

NEW TYPE THERMOMETER FOR CORE OVENS

The Leonard & Baker Stove Co., Taunton, Mass., has taken over the Somerset Stove Foundry Co., Somerset, Mass., and reorganized by electing the following officers: President, C. H. Macomber; treasurer, and F. L. Baker; vice president of the old firm.

Flat-Wheeled Scoop Car

The scoop car trailer shown in the accompanying illustration made by the Easton Car & Construction Co., with offices at 50 Church St., New York, is equipped with flat tread wheels instead of the usual flanged wheels. It is not confined to the limits of a narrow-gage track system; but it may be pulled around anywhere inside or outside the shop by one man.



THE BODY IS MOUNTED ON A TURNTABLE AND CAN BE DUMPED FROM ANY ONE OF THE FOUR SIDES

This new car extends the usefulness of the scoop type in practically all industries in a variety of forms from the handling of steel chips, small forgings, castings, bolts, etc. In the foundry it is adapted to the handling of coke, coal, cinders and sand.

The body, which has a capacity of 2 cubic feet, is mounted on a structural turntable. It may be turned around in any direction and dumped from any one of the four sides. The front axle is of the swivel type, equipped with a machined, cast-iron, ball-bearing turntable which permits the car to be turned in approximately its own length.

Cupola Lining Needs Annular Support

Question—We have a cupola which we line to 48 inches inside diameter. Please tell us whether it is necessary for it to have annular supports for the lining above the melting zone.

Answer—No doubt the lining would last quite a while without the annular supports but its life would be greatly lengthened if annular supports are used above the melting zone to prevent the weight of the column of bricks from bearing on the bricks in this position where they are exposed to the highest temperatures of the cupola. Firebrick begins to soften and becomes weaker at temperatures considerably below the fusing point of the brick.

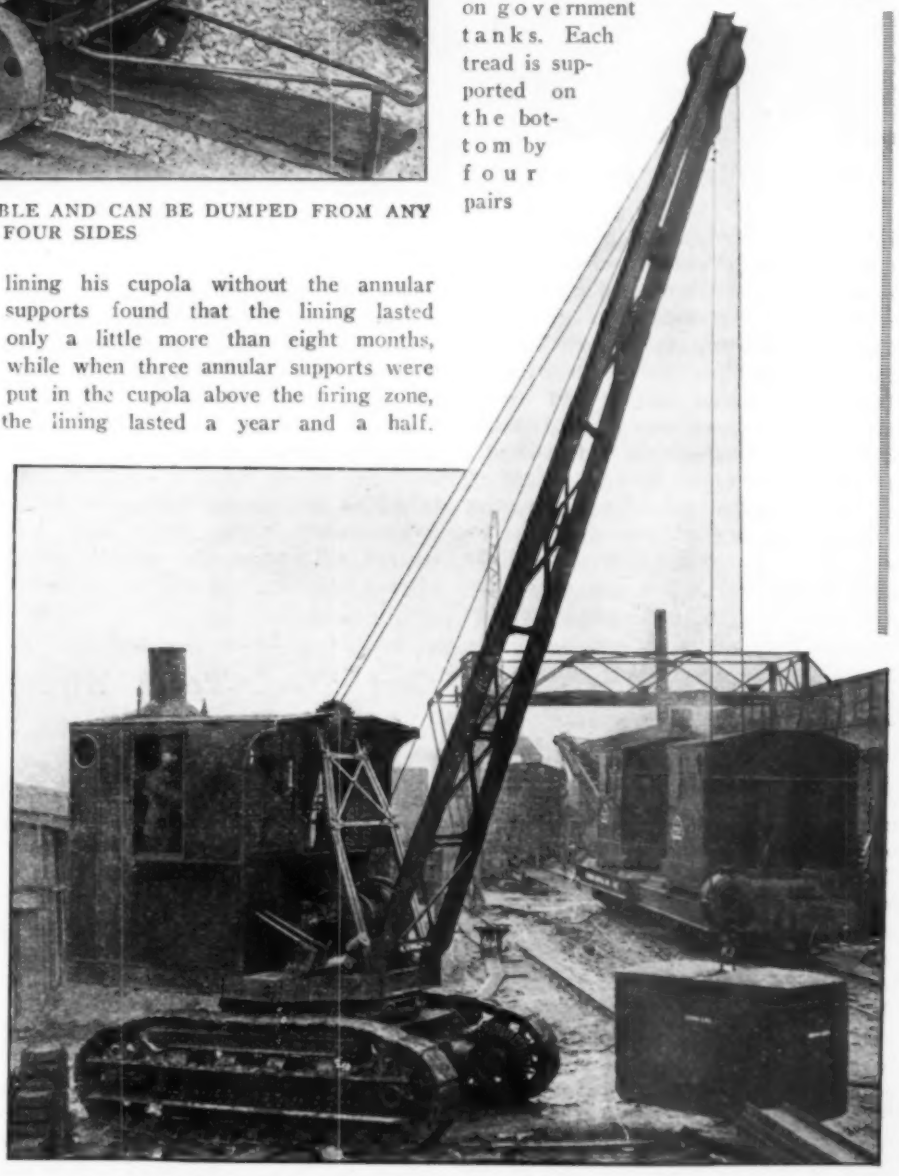
One foundryman who has tried lining his cupola without the annular supports found that the lining lasted only a little more than eight months, while when three annular supports were put in the cupola above the firing zone, the lining lasted a year and a half.

Brass Manufacturers Meet

Members of the National Association of Brass Manufacturers met in Chicago recently and a poll of members showed that while some plants are operating full time and with full complement of workers, the majority have curtailed, and production averages about 75 per cent of capacity. The next meeting will be held at Buffalo early in June, the exact date not being selected.

New Crawl-Type Crane

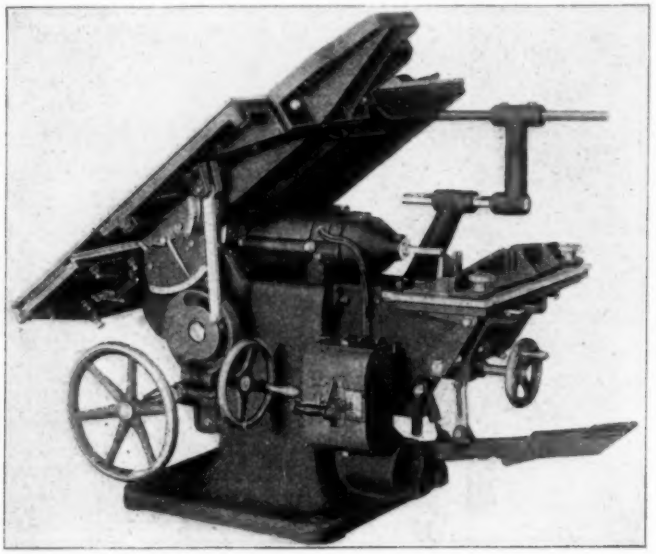
For various phases of material handling, a new crawling tread crane, which may be equipped with a grab bucket or electromagnet, has been developed by the Orton & Steinbrenner Co., Chicago. It is made in both 7 and 12-ton capacities. As shown by the accompanying illustration, the crawling tread is similar to that used on government tanks. Each tread is supported on the bottom by four pairs



THIS CRANE WITH LINK TREAD WILL TRAVEL FORWARD OR BACKWARD

of idler rollers between the drive sprocket and the idler and each pair of rollers is on an equalizing strut backed by heavy coil springs. This device equalizes the pressure of the crane on the ground and enables it to travel up grades of 20 to 30 per cent in soft material.

The hoisting mechanism consists of four main horizontal power shafts driven through a train of cast steel spur gears and three auxiliary vertical shafts driven by cast steel bevel gears, these transmitting the power for the four principal functions of the crane, hoisting, swinging, raising and lowering the boom, and traveling. Any one function may be utilized independently of the others or all may act together. A steam engine provides the motive power. Steering of the crane is accomplished by means of brakes on the differential shaft. For energizing an electromagnet, a turbo-generator set may be installed in the cab.



DIRECT MOTOR DRIVE IS OBTAINED BY PLACING THE MOTOR ON THE SAW ARBOR

Adjustable Saw Bench Meets Many Needs

To provide a machine to accommodate a number of operations in the woodworking and patternmaking field, the Oliver Machine Co., Grand Rapids, Mich., has developed a saw bench which will do ripping, cross cutting, dadoing, mitering and even boring. As shown by the accompanying illustration, the frame is of box form, one-piece casting of broad base and rigid construction. The slide ways are long and deep sectioned. A saw dust chute is cast as part of the frame and runs through the center of the frame, discharging the dust to the right-hand side of the machine and out of the way of the operator.

Either a plain or universal table is furnished. Both are 36 x 44 inches, tilt 45 degrees to the left, and have 4-inch vertical adjustment, the height being 32 inches at the lowest position and 36 inches at the highest. The universal table has a 15-inch rolling section to the left of the saw and rolls on ball bearings. Table tilting is accomplished by a handwheel, worm and gear device housed in a dust proof casing and fastened to a yoke with a connecting link to the table. A 14 or 16-inch saw is mounted on the saw arbor. Belt or motor drive may be specified. With the former, a countershaft is supported by a housing cast in one piece and secured to the base. A screw attachment takes up the stretch of the belt. The tight and loose pulleys are 10-inch diameter and 5-inch face and have a speed of 600 revolutions per minute. The driving pulley is 18-inches diameter with a 5-inch face.

When motor drive of 2 or 3-phase 60-cycle current is used, a 3 to 4-horsepower motor is direct mounted on the saw arbor as shown in the illustration. However the more usual drive, consists of a 5-horsepower motor of 1800 revolutions per minute mounted on a sub-base bolted to the frame. This provides a self-contained motor drive with belt tension adjustment. A suitable guard gives protection from the motor pulley and belt.

Cast Steel Tools Direct From the Furnace

High speed steels today are produced by the electric or crucible process. The proper alloys are introduced to furnish the required cutting qualities. After the steel is cast in ingots it is worked into bars or blanks and in that shape sold to the tool manufacturers who anneal it and then cut it into the desired shape. It is tempered subsequently and ground to size and finish. Obviously, a reamer or twist drill cut from a solid bar represents a large wastage of material and an expensive machining operation.

Efforts have been made at various times to cast high speed steel directly into tool shapes. A limited success has been attained in casting milling machine cutters and reamers but it is only within the past three years that twist drills have been successfully produced in this manner. About three years ago a new process of making high speed steel was developed by the Bird-Archer Co., 90 West Street, New York.

By this process it is claimed that blow holes have been practically eliminated and the metal is a compact, dense, tough, high speed steel that can be cast into any reasonable shape. Its application apparently is without limit since twist drills, reamers, milling cutters, counter sinks and special tools of every description already have been made successfully. The steel made under this process is melted in a ½-ton Greaves-Etchells electric furnace made by the Electric Furnace Construction Co., Philadelphia.

Prepares Special Cement for Brass

The J. W. Paxson Co., Philadelphia, recently has placed on the market a cement for repairing scars, small blow holes and surface blemishes in brass castings. The material is a powder with a special liquid in which to mix it. The cement is mixed to a thick paste and applied. It may be dried in a slow oven or with a torch. Among other applications it is pointed out that the trouble and expense of taking down a pipe line in many cases may be avoided by the use of the cement on leaky joints. The powder is put up in one and five pound packages.

Evans Heads Engineering Advertisers

Keith J. Evans, advertising manager of Joseph T. Ryerson & Son, Chicago, was elected president of the Engineering Advertisers' association at the annual meeting. Mr. Evans succeeds J. J. Arnsfield, advertising manager of the Fairbanks, Morse Co.

Other officers elected were Julius Holl, advertising manager of Link-Belt Co., vice president; D. T. Eastman, advertising manager of the Eagle-Picher Lead Co., secretary and J. H. Patterson, advertising manager of the P. H. & F. M. Roots Co., treasurer. G. S. Hamilton, advertising manager of the Conveyors Corporation of America, Edward I. Pratt, advertising manager of the Kellogg Switchboard & Supply Co., Benjamin Brooks, advertising manager of the Clay Products association, and W. F. Leggett, advertising manager of the Webster Mfg. Co., were the new directors elected.

Equipment Makers Still Mark Time

Although Inquiry is Brisk Little Return is Evident and a Low Point is Registered in Total Volume of Business Transacted by Manufacturers of Foundry Machinery

INQUIRIES in small volume still continue to be received by manufacturers of foundry equipment. These in many cases do not prove to be backed by an actual intention to buy, and some are merely expressive of interest in some new feature of foundry accessories. However, replacement orders are increasing in some sections, notably in the East. Flasks, ladles and smaller foundry sundries again are less in demand, and practically no interest is shown in melting furnaces. Some foreign sales are reported, principally in molding machinery and sand blast equipment.

Eastern Market Made By Replacements

WITH new building projects scarce, business in the eastern foundry equipment market is comprised principally of replacement orders, which are coming out in better volume, a development, due, it is believed, to the increasing sharpness of competition, necessitating better and more efficient equipment. However, the market is far from active, and while orders are probably more numerous, they are all small. Several companies have been incorporated in this district of late, but as yet these concerns have not entered the market for equipment. These companies include the Bronze Novelty Casting Co., Denckla building, Philadelphia, and the Rowan Machine & Foundry Co., 418 Elmwood avenue, Brooklyn. Complete equipment for a foundry to be erected in China, having a capacity of five tons of gray iron daily, is being inquired for by the Keystone Mfg. Co., 115 Broadway, New York city. The equipment includes a 5-ton hand-power crane. This project came up about a year ago, but was shortly after indefinitely postponed. Fire recently damaged one of the shop buildings at the plant of the Briggs-Shaffner Co., Winston-Salem, N. C. This building housed the offices, pattern shop, woodworking shop and pattern storage. The company will probably rebuild.

Light Interest in Vicinity of Pittsburgh

SELLERS of foundry equipment report the dullest period in their history as regards both inquiries and sales. One of the large manufacturers of molding machines reports that while early in March a fairly sizable demand was enjoyed, in the past week this has dropped to practically nothing. The Warren Foundry & Machine Co., Phillipsburg, N. J., closed on a large 6-foot, 3-ton capacity rollover molding machine. From time to time a 50-pound ladle order comes through as well as requests for a limited number of flasks. It is apparent that the larger foundries have all the equipment they need since it is from the small sized foundries that the present limited business is coming. A. O. Frick, vice president and general manager of the Frick Co., Waynesboro, Pa., is in the market for considerable equipment for a Buffalo foundry. The Myerstown Foundry & Machine Co., Myerstown, Pa., is reported to be in the market for miscellaneous machinery for improvements to its plant. The Bond Foundry & Machine Co., Manheim, Pa., is understood to be in need of some equipment. Another prospective purchaser of foundry equipment is the Lathwood Foundry Co., Pittsburgh, which is erecting a $10,000 addition. Only spasmodic purchases of foundry cranes are reported, the latest coming from the Indiana Foundry Co., Indiana, Pa., for a 3-ton crane from the Whiting Corp., Harvey, Ill.

Slack Business in Chicago District

CONTINUED light operation of foundries causes demand for equipment and supplies to remain slack while engineers are unable to push building projects through to the point of contracts, much of the latter condition doubtless being due to untoward labor conditions and high cost of materials. With foundries in many centers operating at not more than 25 per cent and many idle there is no urge toward the purchase of additional equipment and comparatively little is needed in the way of supplies to care for the small tonnage being handled. In the absence of fresh inquiry some old business is being stirred up anew and occasionally an inquiry that seemed to have passed is revived by a question as to the present price. This is especially true of cranes, which have declined about 10 per cent during the past year, but apparently this is not a sufficient concession to tempt buying at this time. There is little demand for cupolas, the most recent sale of equipment of this sort being made a fortnight ago to a Wisconsin melter. To purchase additional land and equipment and increase the working capital, the Hercules Steel Casting Co., 871 Robinson avenue, Milwaukee, has authorized an increase of $100,000 in its capital stock. Frank E. McIntyre is general manager.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

Capitalized at $10,000, the Anchor Bronze Co., New York, recently was incorporated by M. Lovitch, B. J. Kupferman and J. Schaefer, 1703 Washington avenue, New York.

The Port Chester Aluminum Foundry, Inc., Port Chester, N. Y., has been incorporated with a capital stock of $50,000, by A. W. Britton, 34 Cedar street, New York, and a number of others.

The Leonard & Baker Co., Taunton, Mass., has taken over the Somerset Stove Foundry Co., Somerset, Mass., and reorganized by electing the following officers: President, C. H. Macomber; treasurer, E. L. Baker; vice president and assistant treasurer, Lewis J. Lin-

coln and Alfred Tallman, who was formerly treasurer of the old company, will continue in an executive capacity. The reorganized company will continue to manufacture the same line of products.

Arthur D. Reeve, Newark, N. J., plans the erection of a foundry, 40 x 50 feet.

The Cooley Castings Co., Bay City, Mich., is reported planning to enlarge its plant.

The Laurel Mfg. Co., New Philadelphia, O., is having plans prepared for the erection of a foundry and machine shop, 88 x 308 feet.

The Consolidated Foundry Supply Co., Jersey City, N. J., has been organized by W. H. Fitzpatrick, W. George and others.

Smith & Caffery, 2613 Lodi street, Syracuse, N. Y., plan the erection of a pattern shop building, one story, 44 x 88 feet.

Erection of an addition to its plant is reported under consideration by the Lathwood Foundry Co., Pittsburgh.

The Auto Moto Mfg. Co., Dunbar, W. Va., will erect a number of additional plant units, including a foundry, machine shop, etc.

Erection of an extension to its plant is being planned by the Star Car & Foundry Co., Huntington, W. Va.

The Unit Stove & Range Co., Birmingham, Ala., will install equipment for the manufacture of stoves.

The Empire Collapsible Core Co., Inc., Utica, N. Y., has been incorporated with a capital stock of $200,000, by T. L. Wilder, 1533 Taylor avenue, and others.

The Fords Foundry Co., Perth Amboy, N. J., has been incorporated with a capital stock of $50,000, by O. J. Caulfield, Alexander Blaint Jr., and others.

The P. & H. Pattern & Foundry Co., Trenton, N. J., has been incorporated with a capital stock of $125,000, by W. H. and E. R. Patten and John J. Hornyak.

The St. John's Industrial Foundry, St. John's, Mich., is reported contemplating the erection of an addition to its plant, 30 x 50 feet.

The Hanford Iron Works, San Bernardino, Cal., has just completed its steel foundry which is equipped with a 2-ton electric furnace.

The Keystone Iron & Steel Works, Los Angeles, has placed an order for a 3-ton Moore furnace and expects to begin operations in its new foundry in 90 days.

The Economy Pattern Works & Mfg. Co., 2264 East Fifteenth street, Los Angeles, has been organized by B. G. Funk, Charles Reed and others.

The Superior Mill Co., pattern making, North Wilkesboro, N. C., of which E. V. Williams is general manager, plans to establish a plant.

The Herbert Morris, iron foundry, Buffalo, recently was incorporated with a capital stock of $50,000, by C. Baldy, W. C. Warren Jr., and J. F. Connelly.

Charles Tisch, stoves and furnaces, Brooklyn, N. Y., has been incorporated with $300,000 capital stock, by J. J. Ryan, M. and C. Tisch, 31 Irvington place, Brooklyn.

Capitalized at $30,000, the Montauk Bronze Co., Brooklyn, N. Y., recently was incorporated by A. J. Monten, C. Green and J. C. Zimmerli, 563 Hancock street, to engage in the manufacture of bronze and brass products.

The Camp Mfg. Co., Washington and Wood streets, Chicago, has been incorporated with a capital stock of $30,000, by S. B. Wagner, Peter Sweitzer Jr., and Emanuel Garber, to manufacture iron and steel castings, etc.

The Vail Mfg. Co., 3132 South Canal street, Chicago, has been incorporated with a capital stock of $125,000, to engage in the manufacture of steel and brass products, by R. B. Vail Jr., W. J. Vail and others.

The S. R. Costley Foundry Supply & Equipment Co., Columbiana, O., has been incorporated with a capital stock of $50,000, by C. Frederick, M. L. McFadden, T. A. Rendenberger and others.

The Bronze Novelty Casting Corp., Philadelphia, recently was incorporated with a capital stock of $100,000, by E. O. Thomas, M. J. Robinson and H. L. Maris, Denckle building, Philadelphia.

Capitalized at $50,000, the Andy Pattern & Foundry Co., 2222 West Monroe street, Chicago, recently was incorporated by Anton Spyschalski, A. J. Sowinski, Frank Conkiewicz and others.

A few new tools and some additional equipment will be purchased by the Myerstown Foundry Mfg. Co., Myerstown, Pa., according to a report. It is stated the company is planning a number of improvements to its plant.

John B. Astell & Co., Inc., New York, has been incorporated with a capital stock of $50,000, to engage in the manufacture of foundry equipment, by John B. Astell, R. J. Sheridan and W. G. Miller Jr., 128 William street, New York.

The Arcade Malleable Iron Co., Worcester, Mass., has purchased of the Richard French Iron Works its factory building and one acre adjoining, and will use it for storage purposes. The Richard French Iron Works has had plans prepared for a new plant.

The Milwaukee Steel Foundry, 127 South Walter street, Milwaukee, has increased its authorized capital stock to $250,000 by making a new issue of $100,000 of 8 per cent cumulative preferred stock. Burton C. Wait is president and C. W. Inglis, secretary.

Fire recently damaged one of the shop buildings at the plant of the Briggs-Shaffner Co., Winston-Salem, N. C. This building housed the offices, pattern shop, woodworking shop and pattern storage. The company has not decided on its plans, but probably will rebuild.

Reorganization of the Victory Motor Co., Niles, Cal., manufacturer of oil engines, pipe fittings and valves, recently was effected. The new organization will be known as the Victory Mfg. Co. Charles S. James, H. J. James, E. W. McPherson, A. E. Biggins and W. S. Wellington are the incorporators.

In order to purchase additional land and equipment, as well as to increase its working capital, the Hercules Steel Casting Co., 871 Robinson avenue, Milwaukee, has authorized an increase of $100,000 in its capital stock. This makes the total capitalization $400,000. The company manufactures electric steel. Frank E. McIntyre is general manager.

Erection of a plant building is planned by the Highway Engine Co., Defiance, O., on a site which it recently acquired. Actual work on the structure is to be started soon. The Highway Engine Co., which is capitalized at $150,000, will engage in the manufacture of automobile and truck engines.

Due to the fact its original capitalization was too small to finance the complete organization and building of its plant, the Euclid Foundry Co., So. Euclid, O., recently increased its capital stock. The company's plant is now nearing completion and it is expected it will be ready to start production in from four to six weeks. A. C. Denison is manager of the company, which was incorporated some time ago.

Installation of an electric furnace at the plant of the Electric Steel Products Co., Turners Falls, Mass., recently was completed by the Electric Furnace Construction Co., Philadelphia. This latter company also has recently closed a contract for the installation of a large electric heat treating furnace at the plant of the Yale & Towne Mfg. Co., Stamford, Conn.

Plans have been prepared by the Connecticut Blower Co., Inc., Hartford, Conn., for the erection of a number of buildings. One structure, the manufacturing building, will be two stories, 52 x 176 feet. The first floor will house the machine shop while the second will be devoted to the sheet metal department and contain offices, drafting rooms, etc. The foundry building will be 50 x 60 feet and the boiler room, 22 x 30 feet.

The recent fire at the Winthrop Harbor, Ill., plant of the Austin Machinery Corp., while extensive, will not interfere with production of the company's line, according to officials. All equipment built at this plant is being produced at the company's plants at Muskegon, Mich., and Toledo, O. The fire destroyed the unfinished stock warehouse and store rooms, as well as the trenching machinery assembly and paving mixer assembly buildings. The fire did not reach the finished machine warehouse. It is understood reconstruction of the plant will be started immediately.

The D. J. Murray Mfg. Co., Wausau, Wis., has reorganized its official personnel following the retirement of Donald J. Murray, president and general manager since 1881, who leaves active business affairs. Mr. Murray's interests have been acquired by a group of Wausau men, including 30 employes of the company. The new officers are: President, William L. Edmonds; vice president, John D. Ehrmann; secretary, Paul Wolfgram and treasurer, W. B. Heinemann. The company was originally formed in 1874 by Eli Wright. In 1879 Mr. Murray was admitted to partnership and upon the retirement of Mr. Wright in 1881 he reorganized the business as a corporation under the present name, which will continue to be used. For many years the company concentrated on construction and equipment of saw mills. In recent years it has gone into the manufacture of machinery and equipment for pulp and paper mills. The new ownership intends to extend the activities to take wider advantage of its large foundry and machine shops. D. R. Bellinger, of Carthage, N. Y., has been engaged as general manager and will take charge April 15. For some time past he has been manager of the Carthage Machine Works.

New Trade Publications

MONORAIL HOIST—A small illustrated folder has been published by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., in which both floor controlled and cage operated electric monorail hoists are described and illustrated. The illustrations show the hoists in various occupations, both at inside and outside work.

FACTORY BUILDINGS—A 64-page illustrated booklet has been published by Frank D. Chase, Inc., Chicago, in which various plants which the organization has designed are illustrated. The plants shown are engaged in iron and steel and metal products manufacturing. They include the Samson Tractor Co., Janesville, Wis., the Peerless Foundry Co., Cincinnati; the Conlon Electric Washer Co., Cicero, Ill.; the Keith Railway Equipment Co., Hammond, Ind.; Gribben & Sexton Co., Chicago, and various others.

LADLE HEATERS—Oil fuel ladle heaters, for heating small ladles not exceeding 20 inches in diameter, are described and illustrated in a circular recently published by the Mahr Mfg. Co., Minneapolis. These heaters are equipped with burners which operate on the vacuum principle and do not require pressure on the oil tank, according to the folder. They operate on compressed air at any pressure from 30 pounds to 120 pounds and will burn fuel oil or kerosene. Specifications and other data are given.